Spatial and Temporal Characterization of Fine Particulate Matter Mass Concentrations in California, 1980-2002

Final Report

Prepared for California Air Resources Board
Sacramento CA
Contract number 03-350

December 12, 2005

Prepared by

Charles L. Blanchard
Shelley Tanenbaum
Envair
Albany CA 94706

Disclaimer

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

Abstract

Studies of fine particulate matter (PM) levels, trends, and effects in California need a reliable long-term record of ambient fine PM mass concentrations. Systematic measurement of fine PM mass concentrations began nationally with implementation of the Federal Reference Method (FRM) network in 1998 and 1999. However, a variety of other monitoring networks have measured fine PM mass concentrations, other PM size fractions, and related pollutants during various periods of time and at varying numbers of sites in California from 1980 through 2002. We developed an historical record of fine PM mass concentrations by combining data from different monitoring programs, accounting for differences in measurement methods and accuracy. The product of this work is a database consisting of estimates of monthly-average fine PM mass concentrations and their uncertainties at monitoring sites in California for the period from 1980 through 2002.

We investigated the comparability of $PM_{2.5}$ mass concentration measurements from different monitoring networks, reconstructed FRM-equivalent $PM_{2.5}$ mass concentrations from other types of measurements, and estimated the associated uncertainties. We established conversion factors to standardize fine mass measurements from other networks to FRM equivalents. The other networks include the California Air Resources Board (CARB) dichotomous sampler network and a variety of special studies conducted prior to implementation of the FRM network.

Where alternative measurements of fine PM mass were not available, we reconstructed fine mass from PM components measured in other size fractions, light absorption, or light scattering.

Table of Contents

I. INTRODUCTION

Background

Two ongoing epidemiological studies require historical $PM_{2.5}$ databases. "Air Pollution and Cardiovascular Disease in the California Teachers Study Cohort (CTS)" is using an existing data set, the California Teachers' cohort, established by the Northern California Cancer Center and the California Department of Health Services, to study whether long-term exposure to PM (PM_{10} and $PM_{2.5}$) air pollution or to any of several gaseous pollutants is associated with cardiovascular and cardiopulmonary disease incidence or mortality. "A Pilot Study to Quantify Health Benefits of Incremental Improvements in Air Quality" is intended to determine if it is possible to quantify measurable improvements in health that are related to declining air pollutant levels in the SoCAB. Investigators in both studies need a reliable long-term record of ambient fine PM mass concentrations, to be used along with data on other air pollutants and contributing factors.

Systematic measurement of fine PM mass concentrations began nationally with implementation of the Federal Reference Method (FRM) network in 1998 and 1999. However, a variety of other monitoring networks have measured fine PM mass concentrations, other PM size fractions, and related pollutants during various periods of time and at varying numbers of sites in California from 1980 through 2002. Developing a reliable historical record of fine PM mass concentrations necessitates combining data from different monitoring programs, accounting for differences in measurement methods and accuracy. Spatial interpolation of the measurements from the combined databases is then required to generate spatially resolved time series of fine PM mass concentrations throughout California.

Objectives and Scope of Work

The objective of this project is to develop estimates of monthly-average fine PM mass concentrations and their uncertainties at monitoring sites in California for the period from 1988 through 2002 and in the South Coast Air Basin (SoCAB) from 1980 through 2002. The comparability of $PM_{2.5}$ mass concentration measurements from different monitoring

networks is investigated, $PM_{2.5}$ mass concentrations are reconstructed from other types of measurements, and the associated uncertainties are estimated.

Overview

Methods are documented in Section II and in the appendices. Appendix G provides complete documentation of the computer programs that were used. Results are discussed in Section III. The databases that were developed are available from the California Air Resources Board.

II. METHODS

Federal Reference Method (FRM) measurements of $PM_{2.5}$ mass concentrations (fine mass) are available beginning in 1998 or 1999. The US EPA has established a criterion for predictability of FRM fine mass concentrations from other measurements, which is a correlation coefficient of $r^2 > 0.8$. We use this criterion to select measurements suitable for prediction of FRM-equivalent fine mass concentrations. In general, mass concentration measurements, while meeting a criterion of predictability, need not be equivalent to FRM concentrations; they may exhibit either additive or multiplicative biases relative to FRM fine mass concentrations (Motallebi et al., 2003a; 2003b). We established conversion factors to standardize fine mass measurements from other networks to FRM equivalents. The other networks include the California Air Resources Board (CARB) dichotomous sampler network and a variety of special studies conducted prior to implementation of the FRM network (see Figures 1 through 5):

– CalTech – 1982, 1986, 1993; 5-11 sites, SoCAB
– IMPROVE – 1987 – 2002; 8-13 sites, state
– Valley Air Quality Study (VAQS) – 1988 – 1989; 6 sites, SJV
– California Acid Deposition Monitoring Program (CADMP) – 1988 – 1995; 10 sites and 1995-99, 5 sites, statewide
– Two-week sampler (TWS) – 1994 – 2002; 12 sites, SoCAB
– Integrated Monitoring Study, 1995 (IMS95) – 12/95 – 1/96; 10 sites, central CA
– PM Enhancement Program (PTEP) – 1995 – 1996; 6 sites, SoCAB

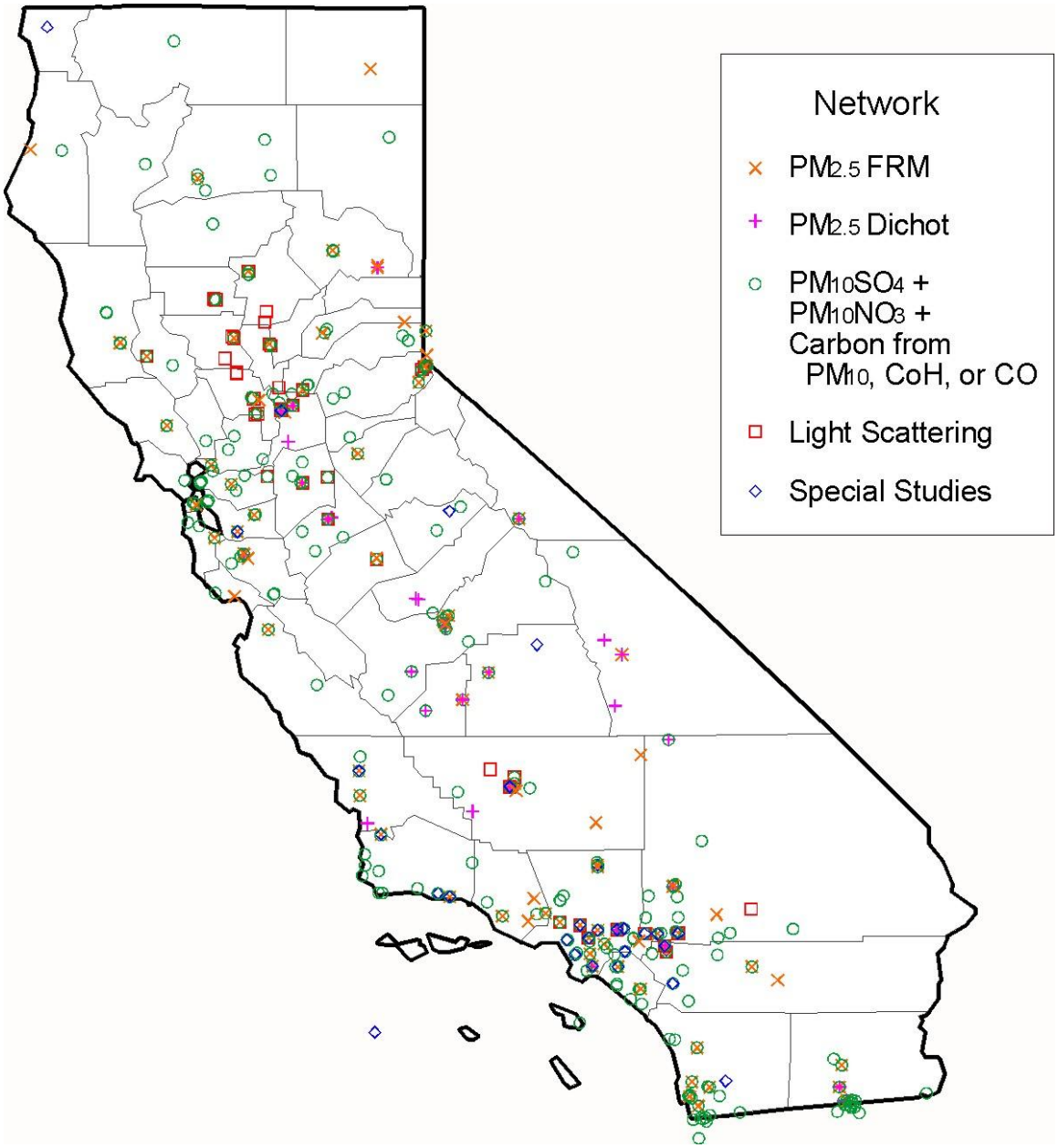

Figure 1. California PM monitoring locations, by network.

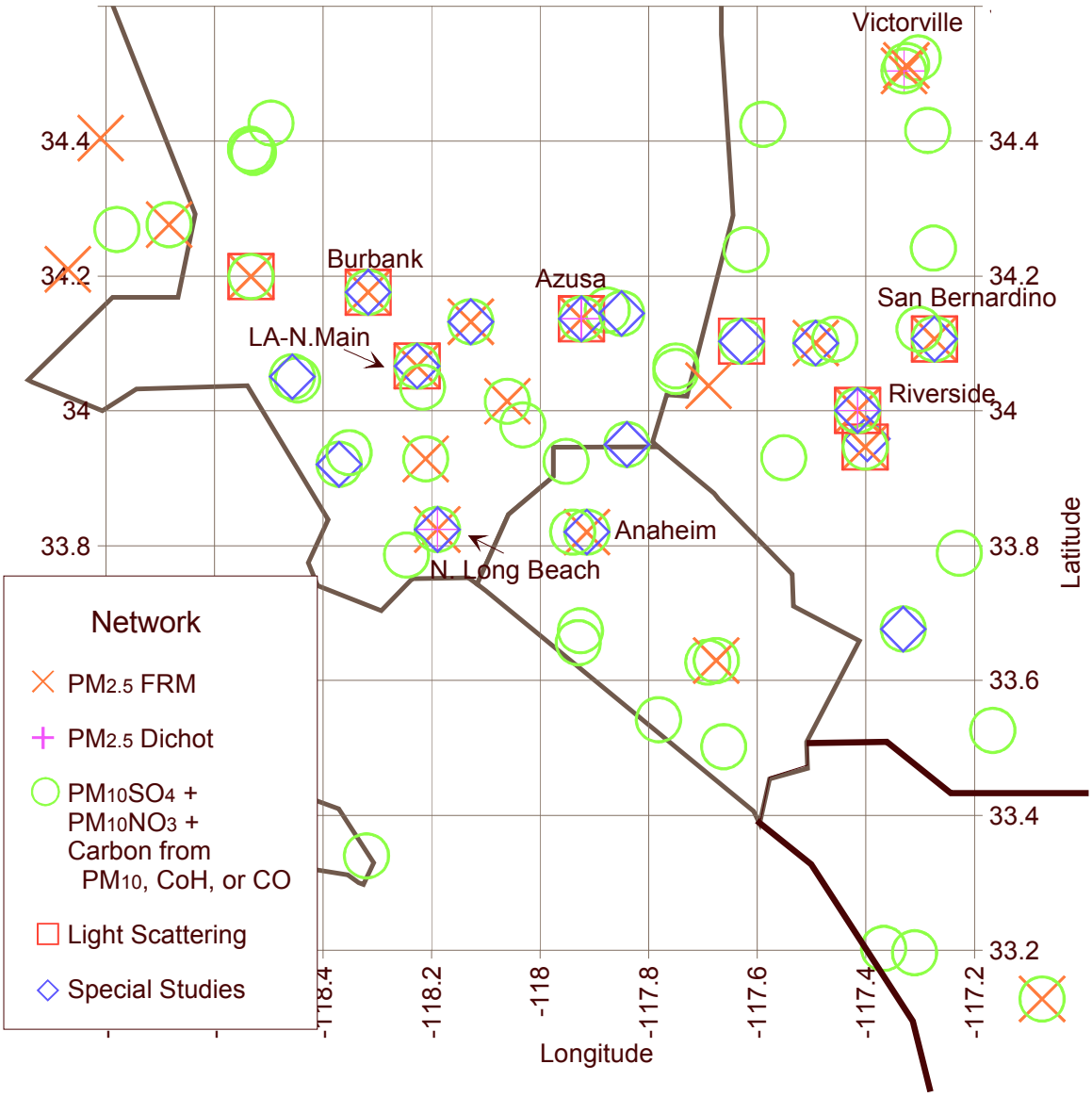

Figure 2. Los Angeles area PM monitoring locations, by network.

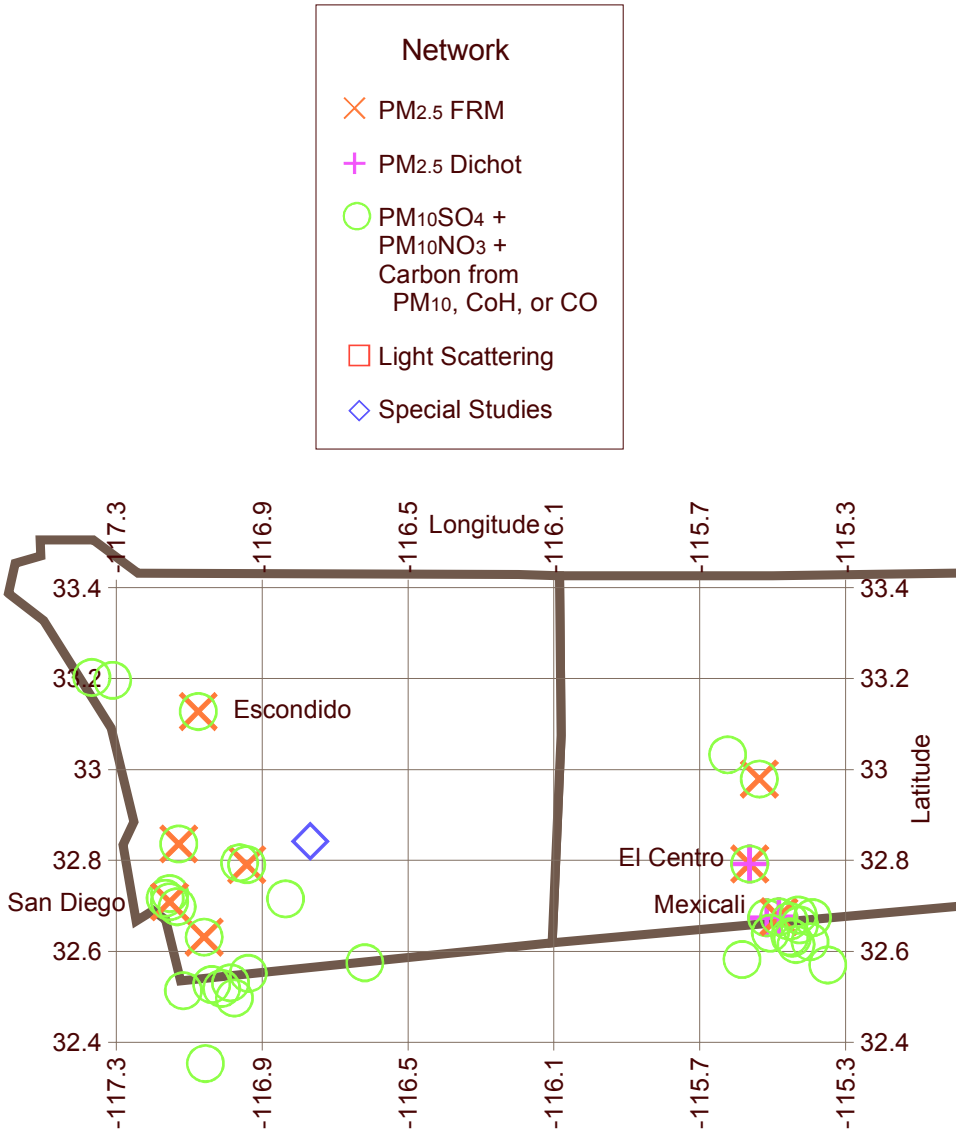

Figure 3. San Diego and Imperial Valley PM monitoring locations, by network.

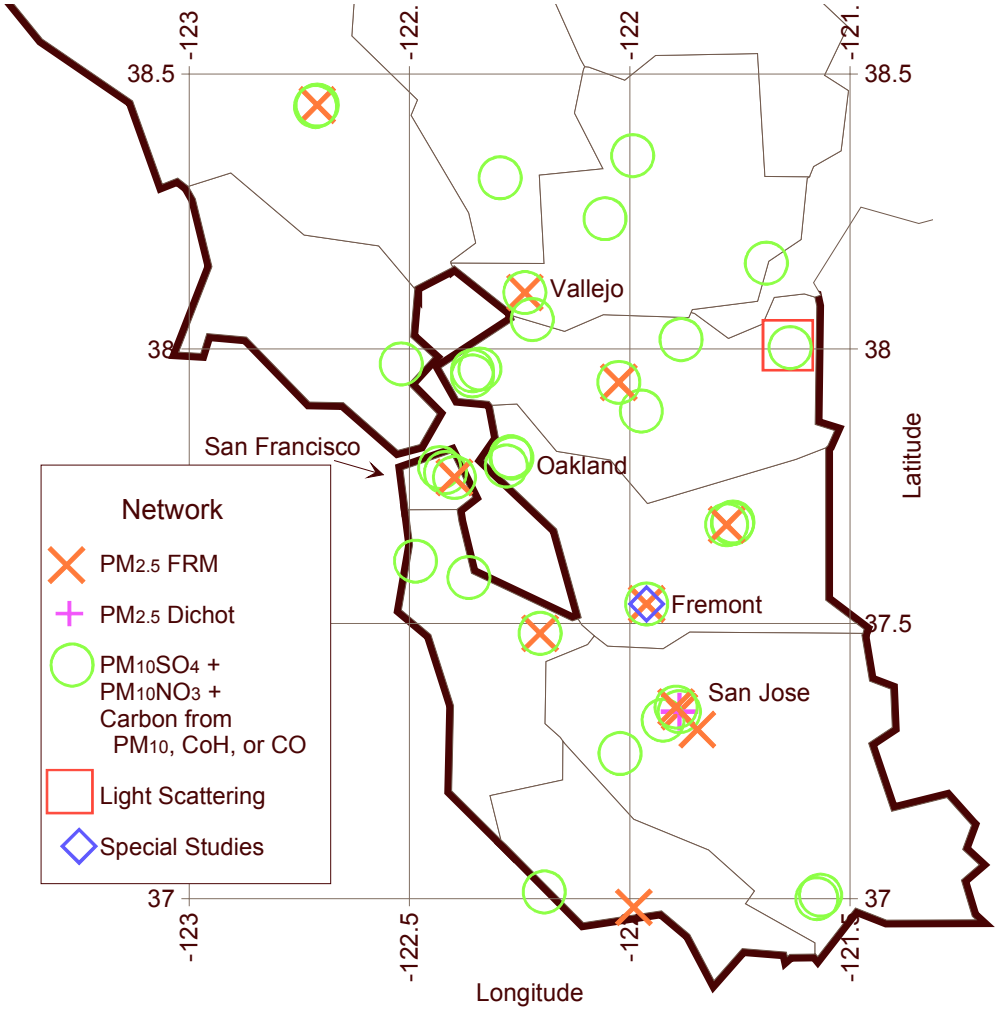

Figure 4. San Francisco Bay area PM monitoring locations, by network.

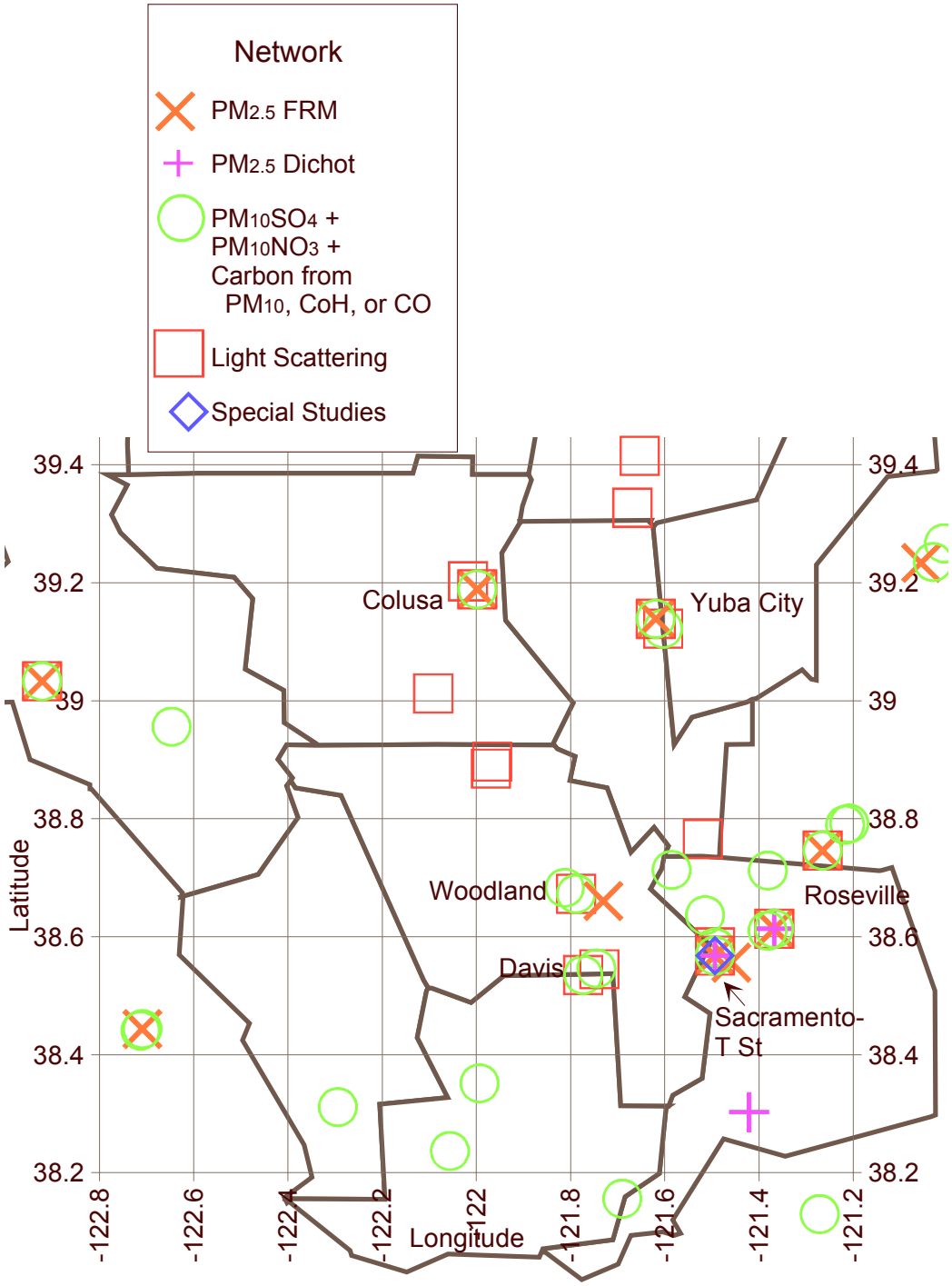

Figure 5. Sacramento Valley PM monitoring locations, by network.

The principal constituents of $PM_{2.5}$ mass in California are organic and black (elemental) carbon, sulfate, and nitrate (McMurry et al., 2004). These PM components, in turn, are typically found primarily in the fine fraction. As a result, it is possible to reconstruct fine mass concentrations and their uncertainties at places and during times without measurements of $PM_{2.5}$ mass using measurements of sulfate, nitrate, and carbon from PM_{10} samples. CARB has developed a substantial monitoring record of PM_{10} sulfate and nitrate concentrations, but PM_{10} measurements of total carbon are limited to a few sites and years. We therefore established correlations between total carbon and related measurements, namely, coefficient of haze (CoH) and carbon monoxide (CO).
We also investigated the comparability of light extinction measurements (nephelometer data) and fine mass concentrations. Fine mass concentrations and nephelometer measurements were well correlated ($r^2 > 0.8$) during the years 1988 – 1994, but were poorly correlated ($r^2 \sim 0.4$) from 1995 - 2002.

In developing monthly averages of measured and reconstructed fine mass constructions, we established a selection priority as follows:

1. FRM fine mass
2. dichotomous sampler fine mass
3. CADMP fine mass and fine mass from other special studies
4. reconstruction from PM_{10} sulfate + nitrate + total carbon
5. reconstruction from PM_{10} sulfate + nitrate + total carbon calculated from CoH
6. reconstruction from PM_{10} sulfate + nitrate + total carbon calculated from CO
7. reconstruction from nephelometer data prior to 1995

For each day of a month, a daily-average PM level was obtained following the preceding priorities. Then, a monthly average was determined from all days in a month having data.

The lengths of the measured and reconstructed fine PM time series records for each monitoring location in California are tabulated in Appendix A.

Appendix B describes the estimation of the uncertainties of the monthly averages.

Appendix C describes the comparability of FRM and dichotomous sampler measurements.

Appendix D describes the comparability of measurements from special studies and from the dichotomous samplers.

Appendix E describes the comparability of FRM fine mass measurements reconstructions of fine mass from PM_{10} components.

Appendix F describes the comparability of light extinction and fine mass measurements from FRM and dichotomous samplers.

Appendix G provides an error analysis (assessment of possible biases, or systematic errors).

Computer programs are documented in Appendix H.

Appendix I lists sites with incomplete information on site locations or elevations.

Appendix J summarizes the QA/QC procedures that we employed.

III. RESULTS

The lengths of the measured and reconstructed fine PM time series records for each monitoring location in California are tabulated in Appendix A, while Appendix B describes the estimation of the uncertainties of the monthly averages.

Temporal Trends

We were able to generate best estimates of monthly average fine PM mass concentrations as far back as 1980 for some sites (Appendix A). Prior to 1985, however, basin averages can vary from year to year because the number of sites and months were limited, with different sites sometimes operating during different years and with no monthly averages available for some months during the first year of record (Tables 1 through 4). Example distributions of the monthly averages of best estimate fine mass and contributing measurements are shown in Figures 6 through 9 for the South Coast, San Joaquin Valley, San Francisco Bay area, and Sacramento Valley air basins. The South Coast shows a downward trend of approximately a factor of two in the basin median fine mass concentration, whereas the temporal record from the San Joaquin Valley appears to indicate an increase during the late 1980s, followed by a decline. Tables 1 through 4 show that in all four air basins, the medians in some years prior to 1985 may be heavily influenced because the data are limited to one or two monitoring locations, partial temporal coverage, or both.

Table 1. Number of site-months with best estimate monthly-average fine PM mass concentrations at sites in the South Coast Air Basin, by year and month.

Year	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	24	2	2	2	2	2	2	2	2	2	2	2	2
1981	23	2	2	2	2	2	2	2	2	2	2	2	1
1982	128	11	11	11	11	11	11	11	11	10	10	10	10
1983	44	3	3	4	4	4	4	4	4	4	4	3	3
1984	47	3	3	3	3	3	3	3	3	3	6	7	7
1985	87	7	8	8	8	7	6	7	7	7	7	7	8
1986	126	10	10	10	10	10	10	11	11	11	11	11	11
1987	108	9	9	9	9	9	9	9	9	9	9	9	9
1988	107	8	9	9	9	9	9	9	9	9	9	9	9
1989	136	10	10	10	10	12	12	12	12	12	12	12	12
1990	146	13	12	12	12	12	12	13	13	13	12	11	11
1991	129	11	11	11	11	11	11	10	10	10	11	11	11
1992	131	11	10	11	11	11	11	11	11	11	11	11	11
1993	128	11	11	11	11	11	11	11	11	10	10	10	10
1994	154	13	10	9	13	14	14	13	14	14	14	12	14
1995	173	14	10	15	16	12	15	16	16	15	15	15	14
1996	173	15	16	15	15	15	15	13	13	14	15	15	12
1997	159	13	14	14	14	14	13	13	13	13	12	13	13
1998	163	14	12	14	14	14	14	14	13	13	13	14	14
1999	258	19	20	21	22	21	21	21	22	23	22	23	23
2000	269	23	23	23	23	23	23	22	21	22	22	22	22
2001	260	21	22	22	22	22	22	21	20	22	22	22	22
2002	263	22	22	22	22	22	22	22	21	22	22	22	22
Total	3236	265	260	268	274	271	272	270	268	271	273	273	271

Table 2. Number of site-months with best estimate monthly-average fine PM mass concentrations at sites in the San Joaquin Valley Air Basin, by year and month.

Year	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	7	0	0	0	0	0	0	0	0	0	1	3	3
1982	27	3	3	3	2	2	2	2	2	2	2	2	2
1983	24	2	2	2	2	2	2	2	2	2	2	2	2
1984	38	2	2	2	2	2	2	3	5	4	5	5	4
1985	64	4	5	5	5	5	5	5	6	6	6	6	6
1986	79	6	6	6	6	6	7	7	7	7	7	7	7
1987	84	7	7	7	7	7	7	7	7	7	7	7	7
1988	102	8	8	8	8	9	9	9	9	9	8	9	8
1989	135	9	11	11	12	12	12	12	12	11	11	11	11
1990	131	10	10	10	11	11	11	11	11	11	11	12	12
1991	156	12	13	13	14	14	14	13	13	12	13	13	12
1992	156	12	12	12	12	12	13	14	14	14	14	14	13
1993	167	14	14	14	14	14	14	13	14	14	14	14	14
1994	159	14	14	13	14	14	13	13	13	13	13	13	12
1995	123	11	11	11	11	10	11	11	11	8	8	10	10
1996	125	11	11	11	12	11	10	10	10	10	10	10	9
1997	120	10	10	10	10	10	10	10	10	10	10	10	10
1998	116	10	10	10	10	10	9	9	11	10	9	9	9
1999	129	10	10	10	11	11	11	11	11	11	11	11	11
2000	144	12	13	12	12	12	11	12	12	12	12	12	12
2001	137	10	12	12	12	12	12	12	12	11	11	11	10
2002	139	11	11	11	11	12	12	12	12	12	12	12	11
Total	2362	188	195	193	198	198	197	198	204	196	197	203	195

Table 3. Number of site-months with best estimate monthly-average fine PM mass concentrations at sites in the San Francisco Bay Area Air Basin, by year and month.

Year	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	3	0	0	0	0	0	0	0	0	0	1	1	1
1982	11	1	1	1	1	1	1	1	1	1	1	1	0
1983	6	0	0	0	0	1	1	1	1	1	1	0	0
1984	9	0	0	0	0	0	1	1	1	1	1	2	2
1985	24	2	2	2	2	2	2	2	2	2	2	2	2
1986	83	2	4	7	8	8	8	8	8	8	8	7	7
1987	96	8	8	8	8	8	8	8	8	8	8	8	8
1988	103	8	8	8	8	8	9	9	9	9	9	9	9
1989	124	9	9	10	10	10	10	11	11	11	11	11	11
1990	131	11	10	11	11	11	11	11	11	11	11	11	11
1991	132	11	11	11	11	11	11	11	11	11	11	11	11
1992	132	11	11	11	11	11	11	11	11	11	11	11	11
1993	132	11	11	11	11	11	11	11	11	11	11	11	11
1994	140	11	11	11	11	11	11	12	12	12	12	13	13
1995	147	13	13	13	12	12	12	12	12	12	12	12	12
1996	144	12	12	12	12	12	12	12	12	12	12	12	12
1997	145	12	12	12	12	13	12	12	12	12	12	12	12
1998	138	12	12	12	12	12	12	11	11	11	11	11	11
1999	147	11	11	12	12	12	12	12	13	13	13	13	13
2000	156	13	13	13	13	13	13	13	13	13	13	13	13
2001	144	13	13	13	13	13	13	9	9	9	13	13	13
2002	163	14	14	14	14	13	13	13	13	13	14	14	14
Total	2310	185	186	192	192	193	194	191	192	192	198	198	197

Table 4. Number of site-months with best estimate monthly-average fine PM mass concentrations at sites in the Sacramento Valley Air Basin, by year and month.

Year	Total	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1980	51	3	3	4	4	4	4	3	4	5	6	6	5
1981	62	5	5	5	5	5	5	5	5	5	6	6	5
1982	96	6	6	6	6	8	8	8	9	9	10	10	10
1983	118	10	9	9	10	10	10	10	10	10	10	10	10
1984	129	10	10	10	10	10	11	12	12	11	11	11	11
1985	123	11	11	11	10	10	10	10	10	10	10	10	10
1986	123	10	10	10	10	10	10	10	10	10	11	11	11
1987	129	11	11	11	11	11	10	10	10	11	11	11	11
1988	126	11	11	11	11	10	9	10	10	10	11	11	11
1989	130	11	11	11	11	11	9	9	11	11	12	12	11
1990	133	11	11	11	11	11	11	11	11	12	11	11	11
1991	114	9	8	9	8	8	9	10	10	11	11	11	10
1992	123	10	10	10	10	10	10	10	10	11	11	11	10
1993	126	10	9	11	11	11	11	10	10	11	11	11	10
1994	126	9	9	9	9	9	10	9	12	13	13	13	11
1995	61	5	5	5	5	5	5	4	4	4	7	7	5
1996	69	5	5	5	4	5	5	5	5	7	9	9	5
1997	72	5	5	5	5	5	5	5	5	9	9	9	5
1998	71	5	5	4	5	4	4	4	4	9	9	9	9
1999	119	10	11	11	10	10	10	10	9	10	10	9	9
2000	108	10	10	9	9	9	9	9	10	9	8	8	8
2001	114	8	10	10	10	10	10	10	9	10	9	9	9
2002	104	7	7	9	9	9	9	9	9	9	9	9	9
Total	2427	192	192	196	194	195	194	193	199	217	225	224	206

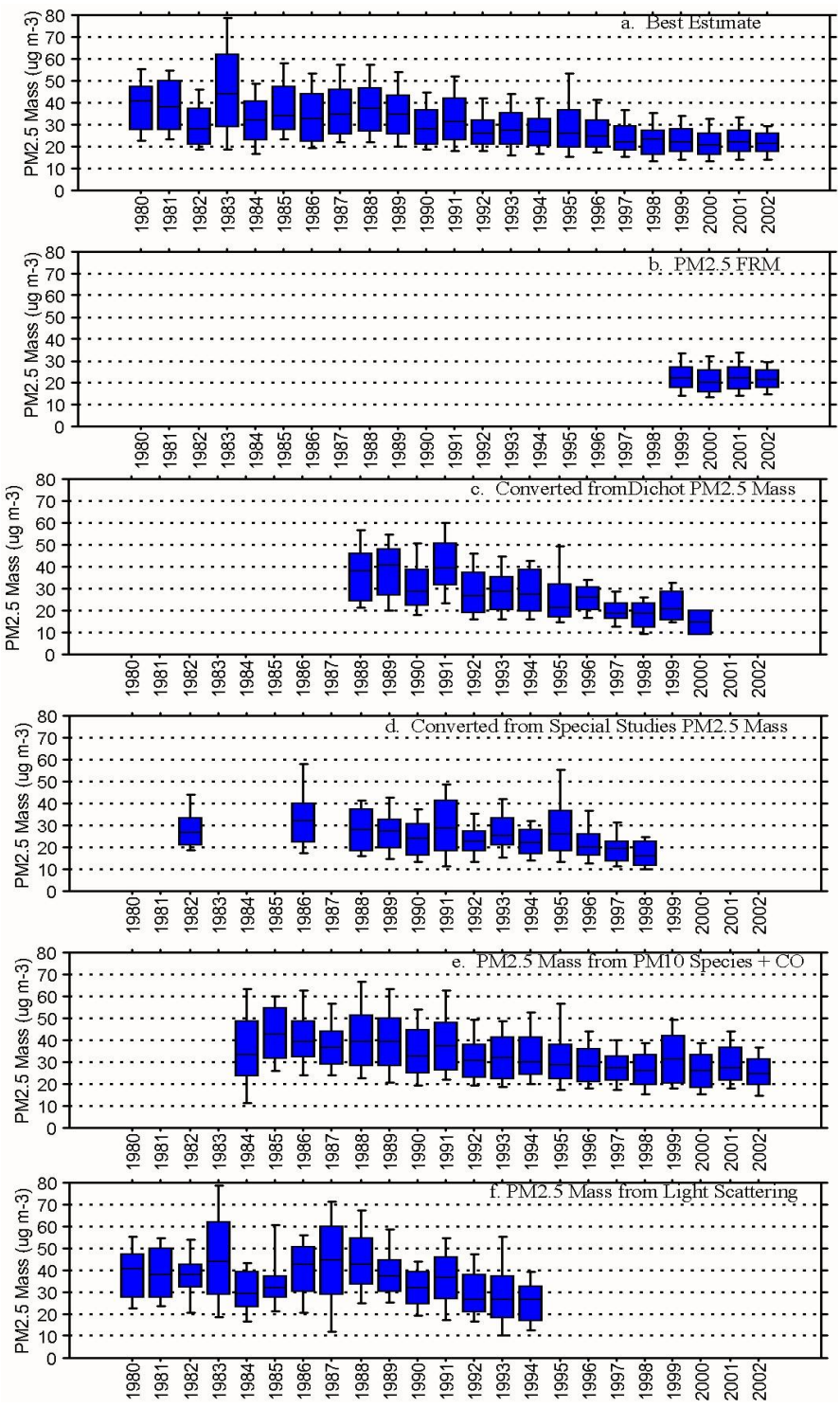

Figure 6. Distributions of monthly-average fine mass concentrations at sites in the South Coast air basin, by year. All measurements have been converted to FRM-equivalent concentrations. Data prior to 1985 derive from a limited number of sites and months and may not represent basin averages as well as measurements from later years.

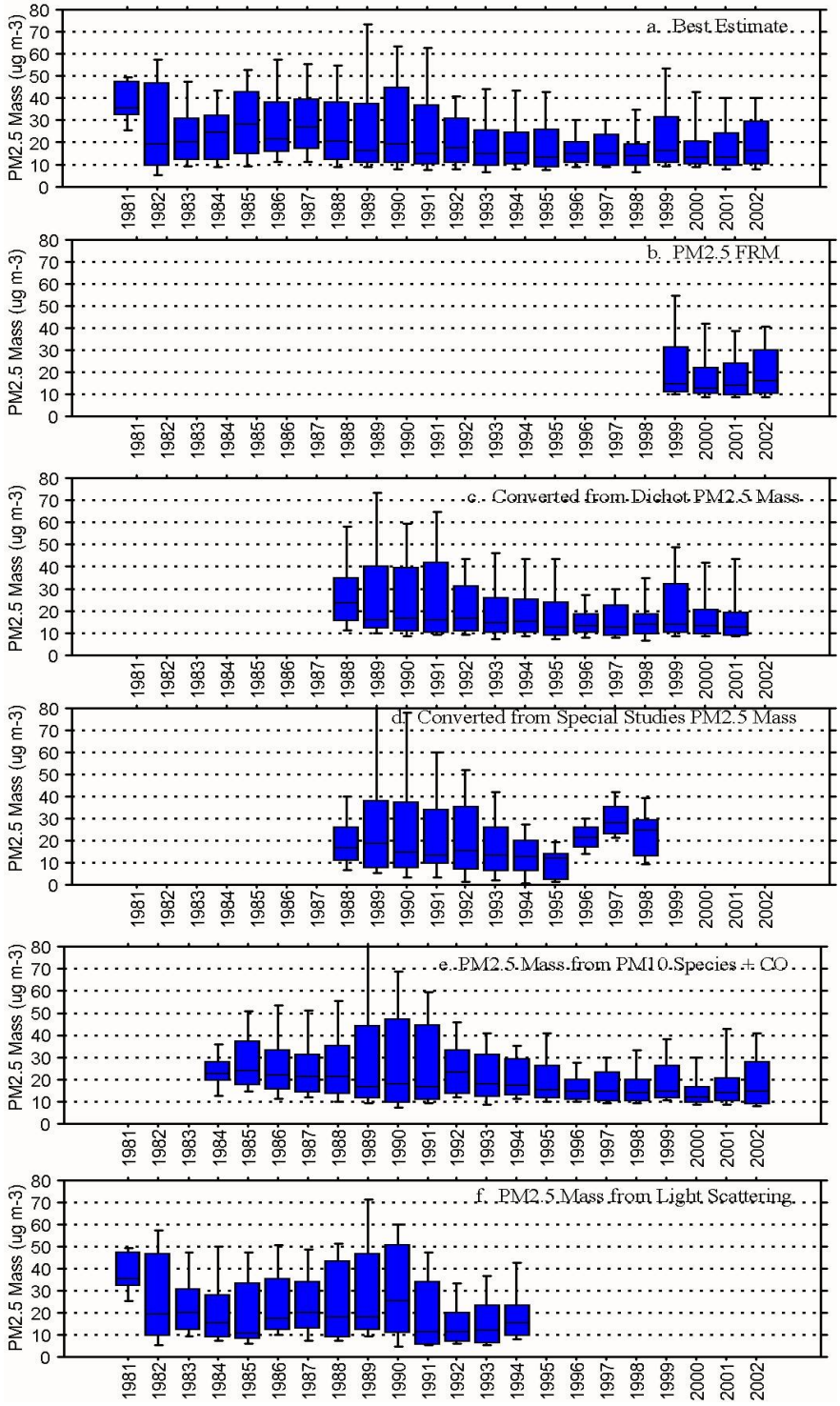

Figure 7. Distributions of monthly-average fine mass concentrations at sites in the San Joaquin Valley, by year. All measurements have been converted to FRM-equivalent concentrations. Data prior to 1985 derive from a limited number of sites and months and may not represent basin averages as well as measurements from later years.

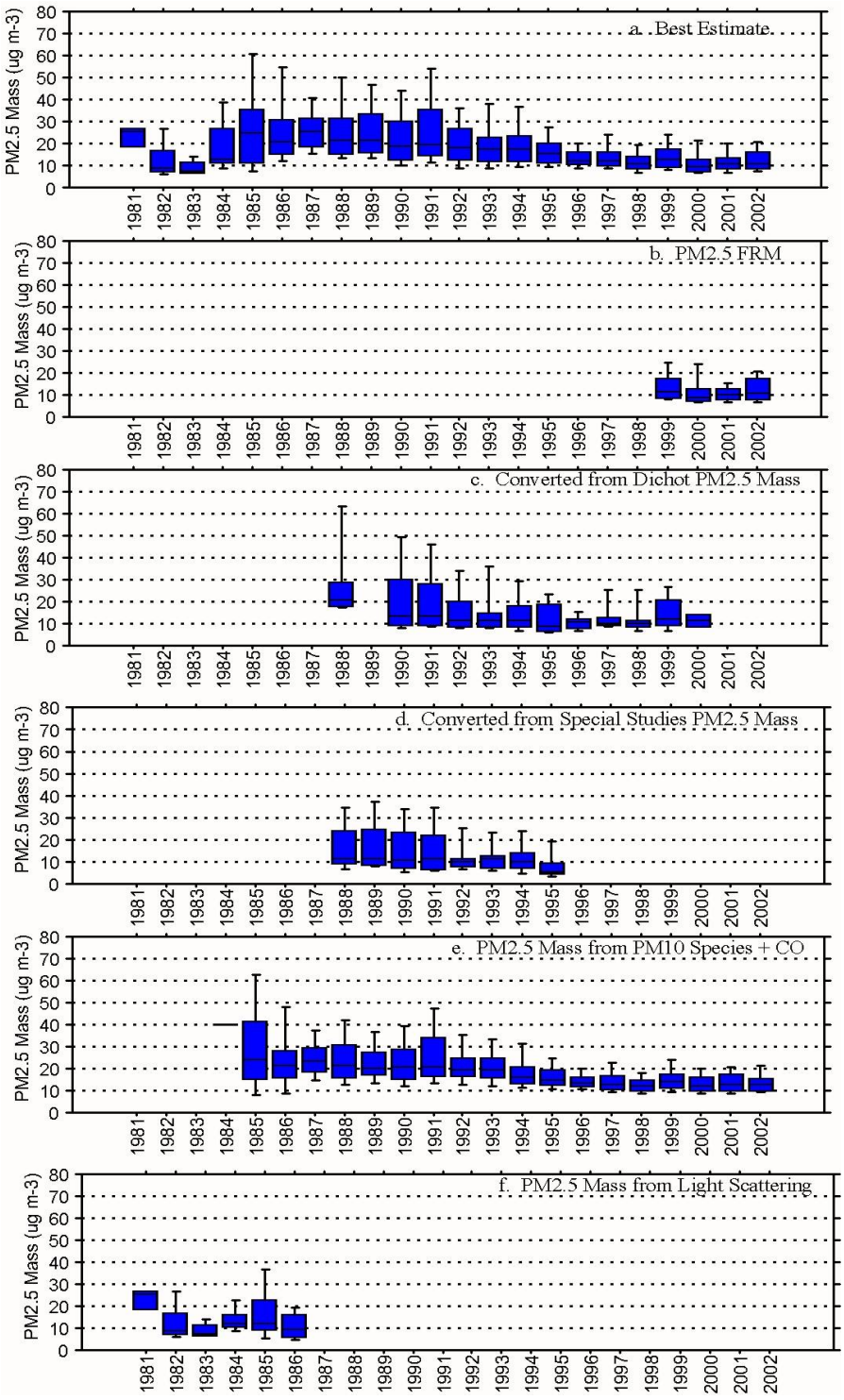

Figure 8. Distributions of monthly-average fine mass concentrations at sites in the San Francisco Bay Area, by year. All measurements have been converted to FRM-equivalent concentrations. Data prior to 1985 derive from a limited number of sites and months and may not represent basin averages as well as measurements from later years.

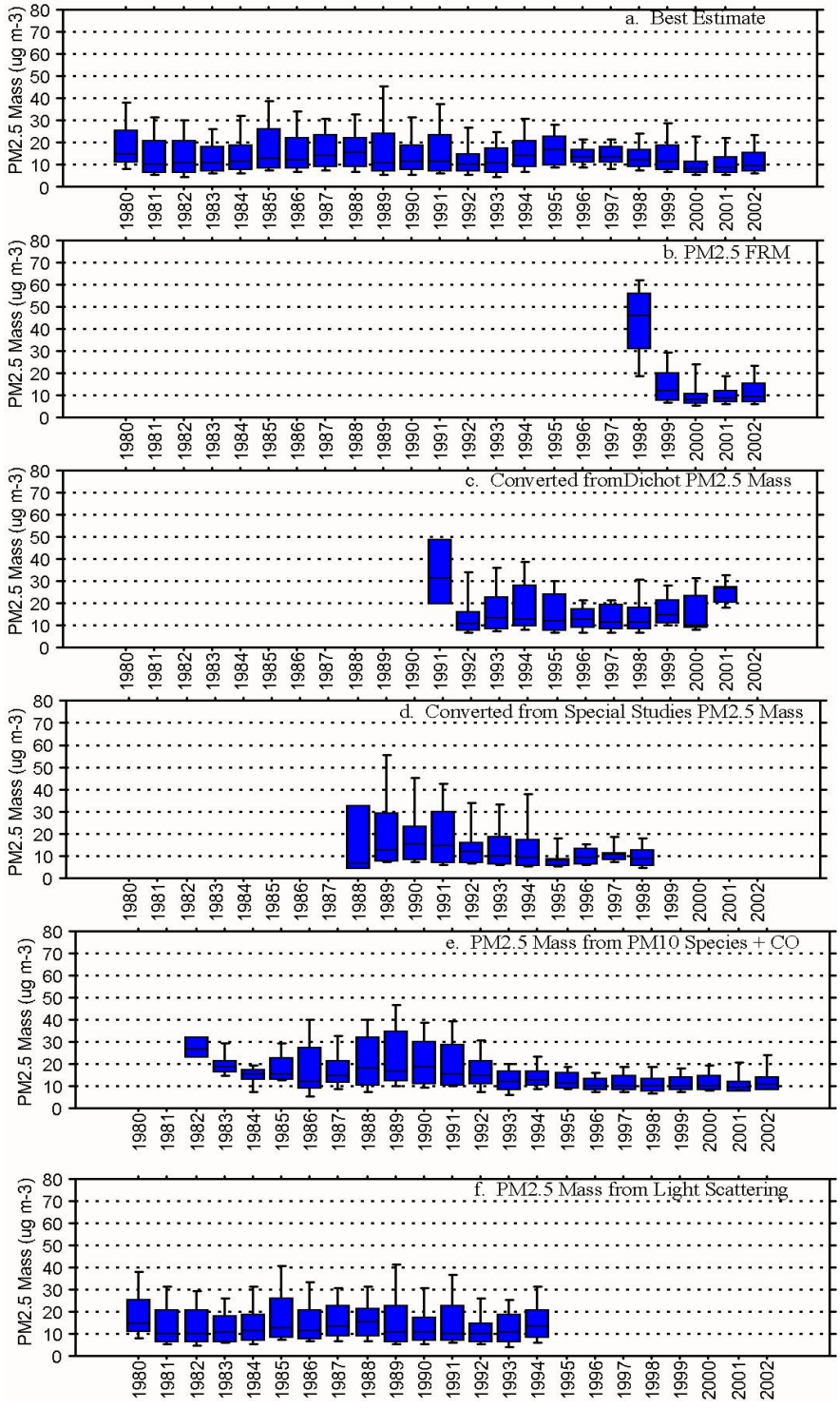

Figure 9. Distributions of monthly-average fine mass concentrations at sites in the Sacramento Valley, by year. All measurements have been converted to FRM-equivalent concentrations. Data prior to 1985 derive from a limited number of sites and months and may not represent basin averages as well as measurements from later years.

Spatial Patterns

Comparisons of multiyear averages show that reductions of average fine PM concentrations occurred in most areas between 1988-1992 and 1998-2002 (Figures 10 through 15). During both the earlier and the later periods, the multiyear mean fine PM mass concentrations were greater at sites in southern California and the San Joaquin Valley than in the San Francisco Bay area or the Sacramento Valley (Figures 10 and 11). By the more recent period, mean concentrations ranged from 20 to 30 $\mu g\ m^{-3}$ in the South Coast air basin and from 10 to 20 $\mu g\ m^{-3}$ at most sites in other areas (Figure 11). In the San Joaquin Valley, many urban sites (e.g., Fresno, Bakersfield) exhibited means of 20 to 30 $\mu g\ m^{-3}$ while less urban locations showed means from 10 to 20 $\mu g\ m^{-3}$.

Observed at finer spatial resolution and scaling, each air basin exhibited patterns of spatial variation during the earlier time period (Figures 12 through 15). By 1998-2002, the amount of spatial variation within air basins had diminished. However, in the Los Angeles air basin, sites at Burbank and in San Bernardino and Riverside counties continued to show higher mean PM values during 1998-2002 than did other sites, albeit the levels at all sites were lower than in 1988-1992 (Figure 12).

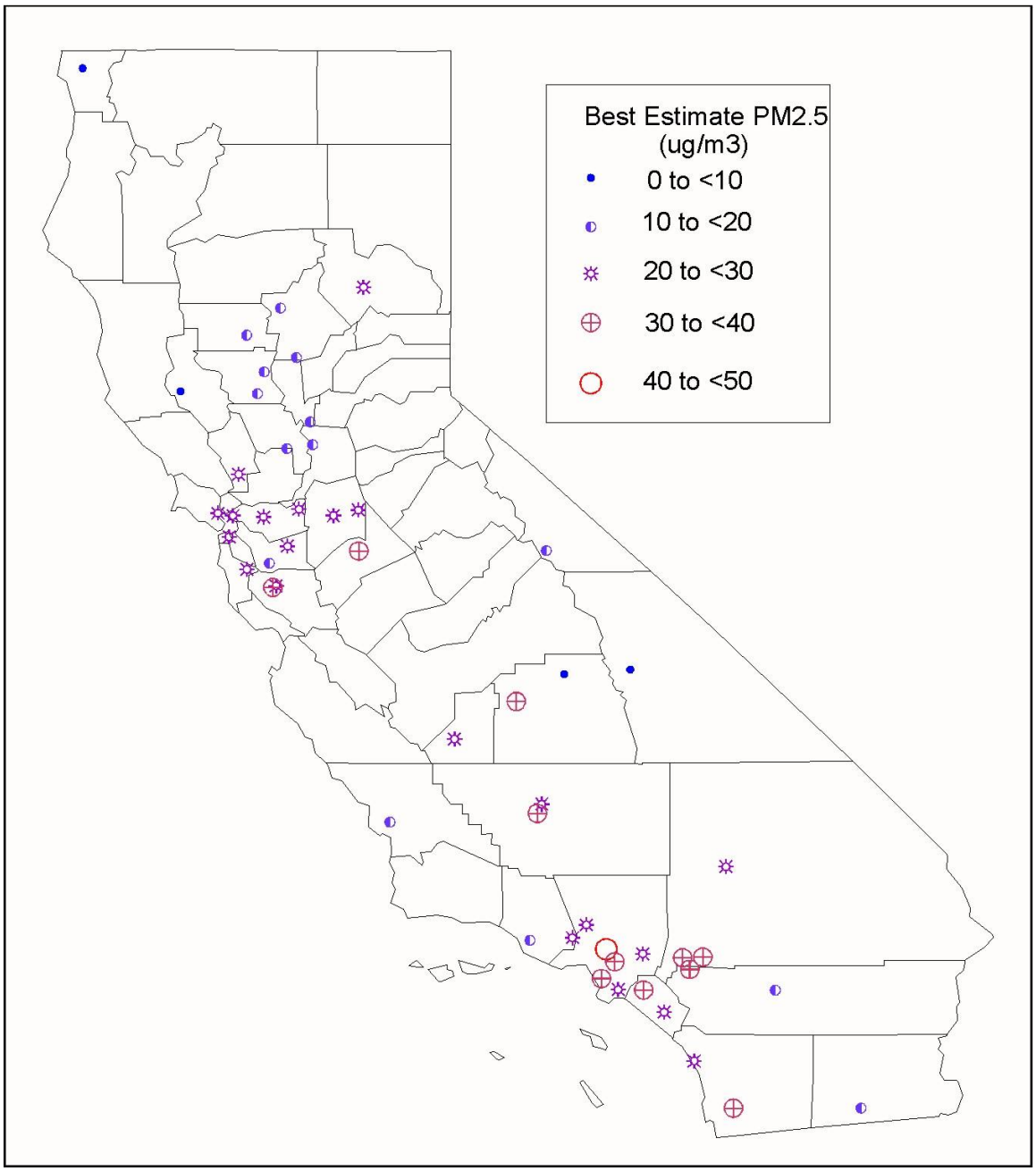

Figure 10. Spatial distribution of mean $PM_{2.5}$ mass concentration statewide, 1988-1992. The multiyear averages were determined from the monthly-average best estimates of $PM_{2.5}$ mass concentration at each site. Each site that is shown reported measurements from at least 11 months during each three-month season of the five-year period.

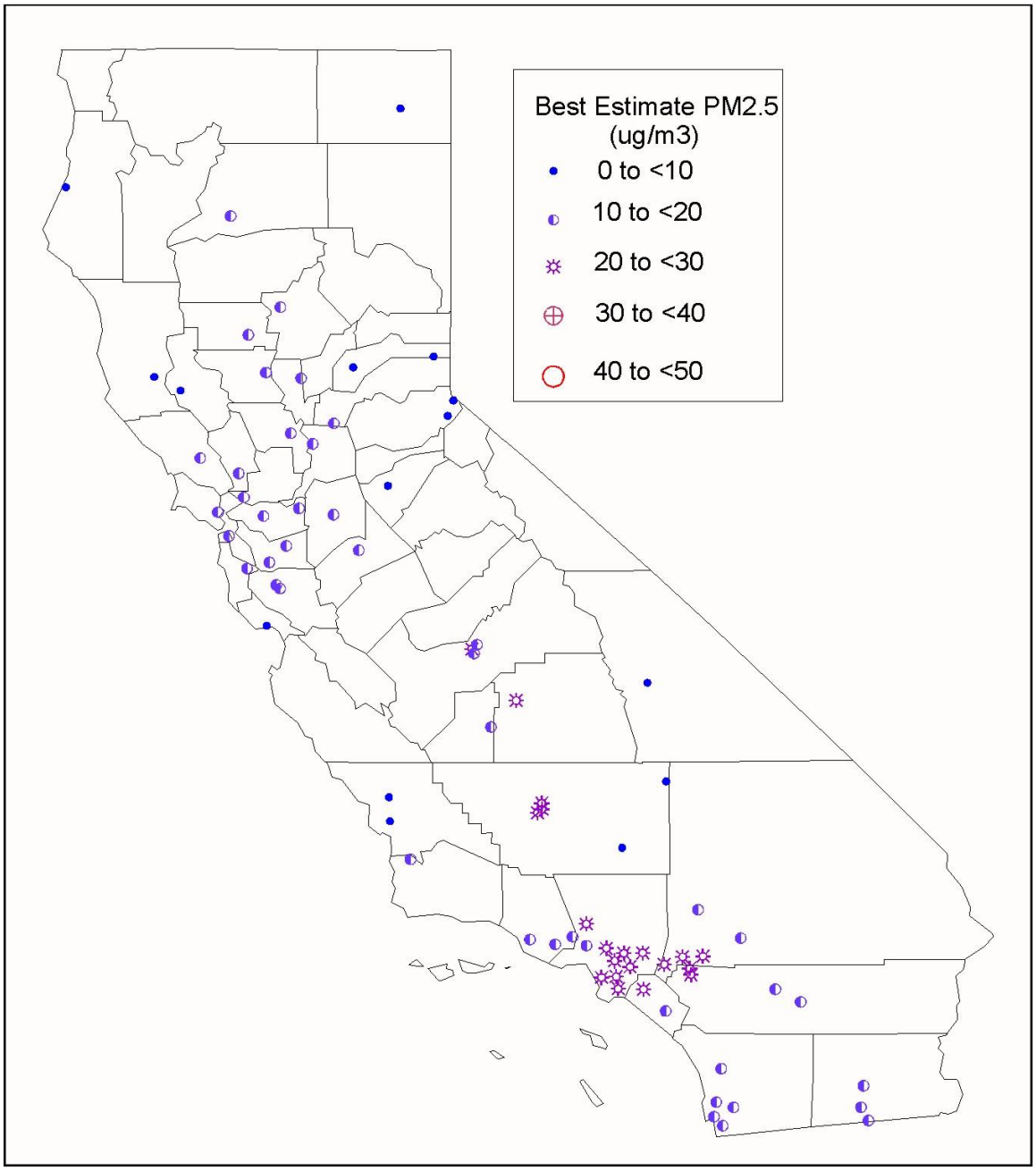

Figure 11. Spatial distribution of mean $PM_{2.5}$ mass concentration statewide, 1998-2002. The multiyear averages were determined from the monthly-average best estimates of $PM_{2.5}$ mass concentration at each site. Each site that is shown reported measurements from at least 11 months during each three-month season of the five-year period.

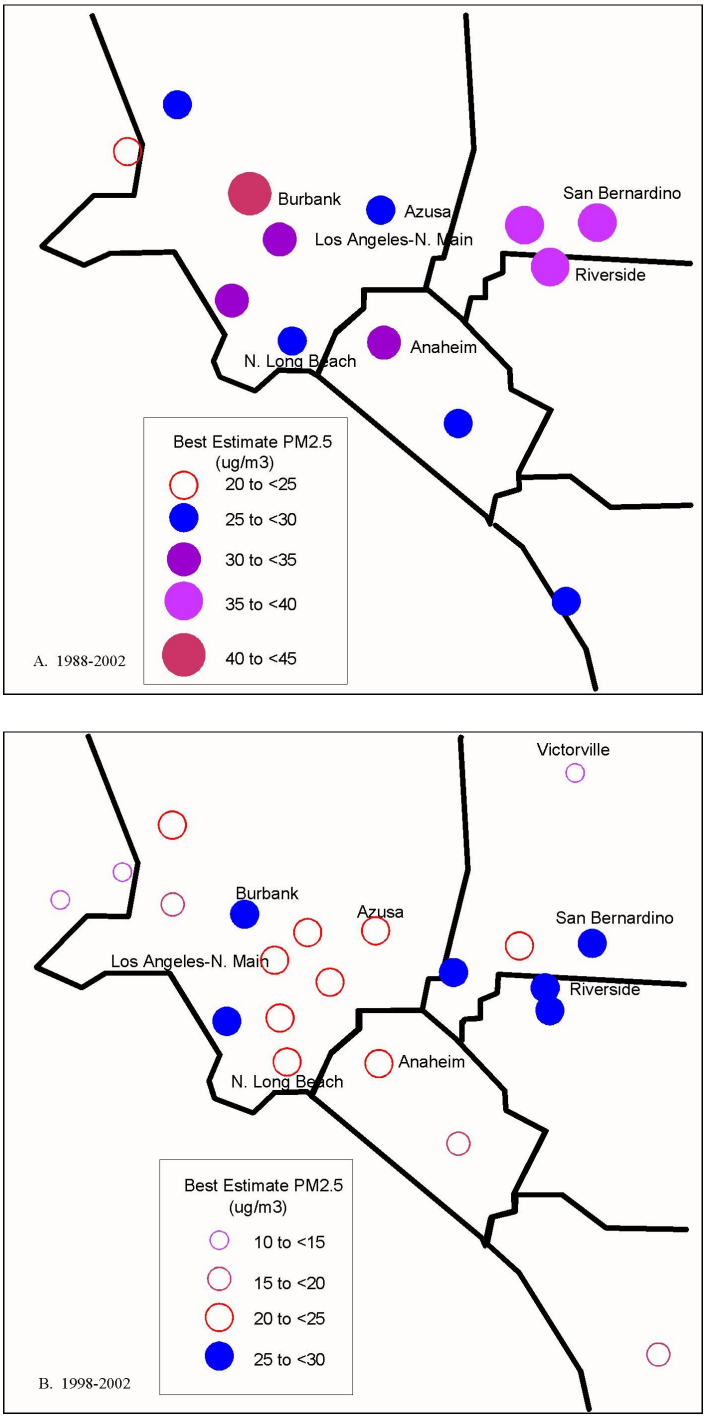

Figure 12. Spatial distribution of mean $PM_{2.5}$ mass concentration in the Los Angeles area, 1988-1992 (top) and 1998-2002 (bottom). The multiyear averages were determined from the monthly-average best estimates of $PM_{2.5}$ mass concentration at each site. Each site that is shown reported measurements from at least 11 months during each three-month season of the five-year period.

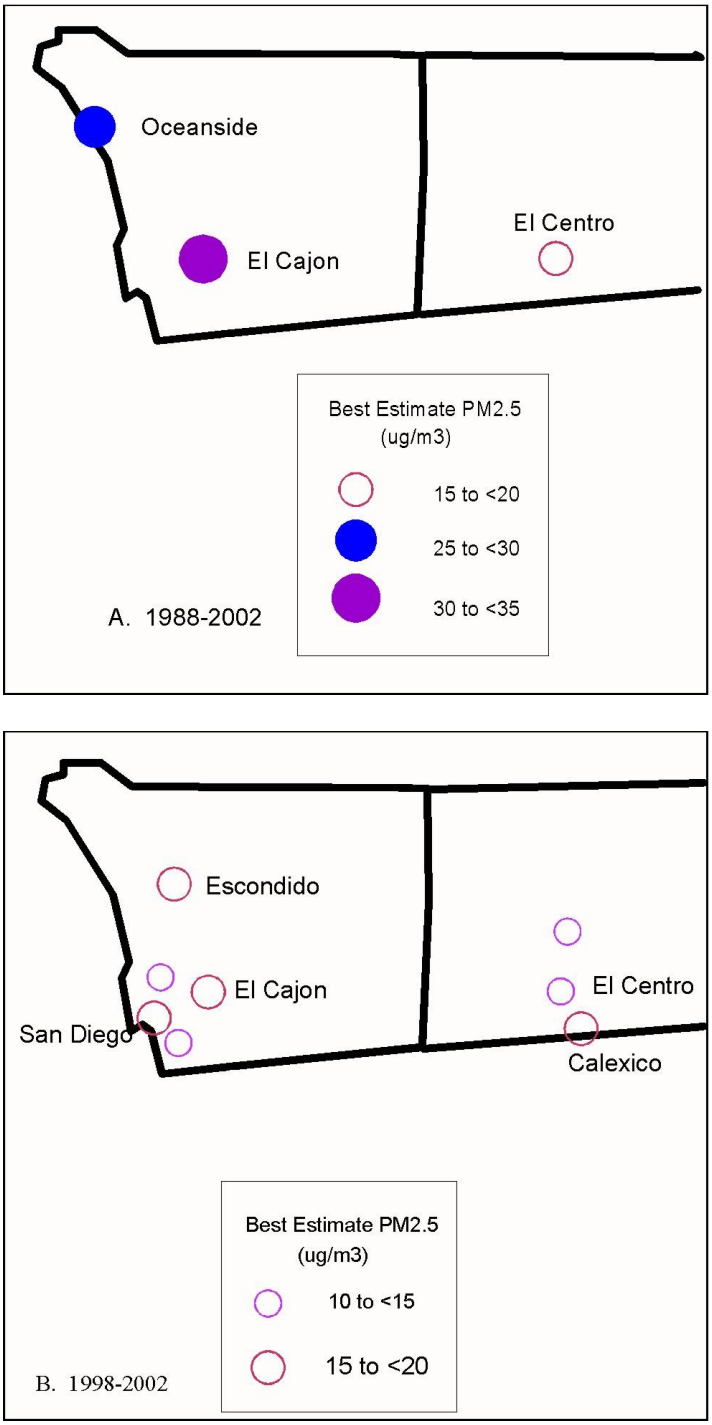

Figure 13. Spatial distribution of mean $PM_{2.5}$ mass concentration in the San Diego and Imperial Valley areas, 1988-1992 (top) and 1998-2002 (bottom). The multiyear averages were determined from the monthly-average best estimates of $PM_{2.5}$ mass concentration at each site. Each site that is shown reported measurements from at least 11 months during each three-month season of the five-year period.

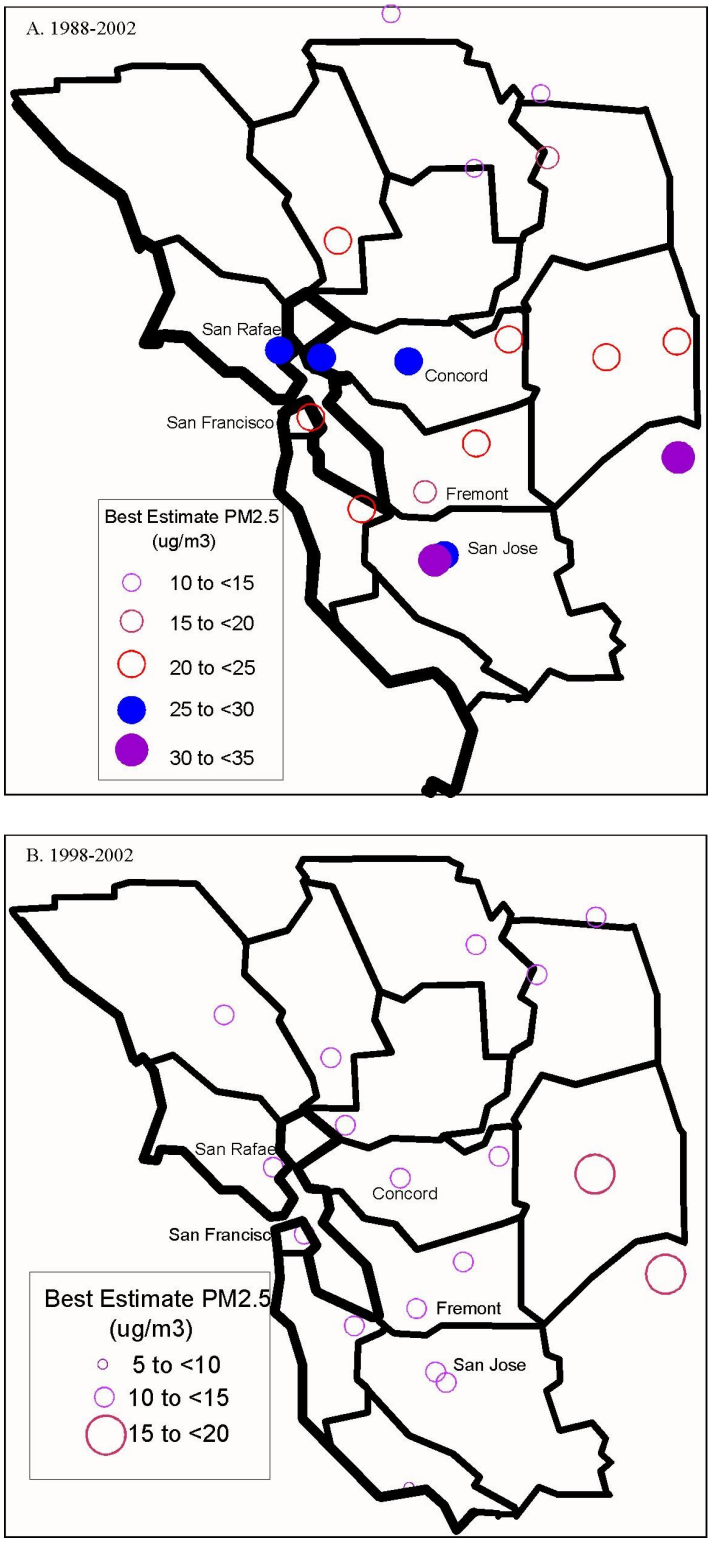

Figure 14. Spatial distribution of mean $PM_{2.5}$ mass concentration in the San Francisco Bay area, 1988-1992 (top) and 1998-2002 (bottom). The multiyear averages were determined from the monthly-average best estimates of $PM_{2.5}$ mass concentration at each site. Each site that is shown reported measurements from at least 11 months during each three-month season of the five-year period.

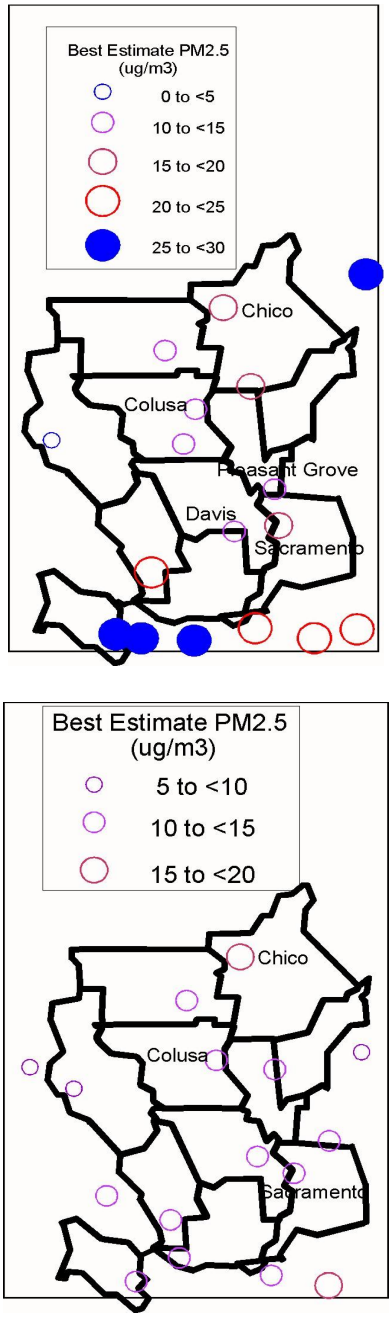

Figure 15. Spatial distribution of mean $PM_{2.5}$ mass concentration in the Sacramento Valley, 1988-1992. The multiyear averages were determined from the monthly-average best estimates of $PM_{2.5}$ mass concentration at each site. Each site that is shown reported measurements from at least 11 months during each three-month season of the five-year period.

IV. CONCLUSION

We developed an historical record of fine PM mass concentrations by combining data from different monitoring programs, accounting for differences in measurement methods and accuracy. The product of this work is a database consisting of estimates of monthly-average fine PM mass concentrations and their uncertainties at monitoring sites in California for the period from 1980 through 2002. The monthly averages of measured and reconstructed fine PM mass are available for 174 monitoring locations, 66 of which have data for at least 60 months (5 years).

The principal objective of this project was the creation of the unified database, which is now available for use in analyses of air quality trends, health effects studies, or other areas of research and policy interest. Although this project did not focus on the analysis of the measurements, simple summary presentations show that fine PM mass concentrations declined substantially – in some cases by a factor of two – at nearly all monitoring locations in California. Site-to-site variations of average fine PM mass concentrations – typically, by about 5 to 10 $\mu g\ m^{-3}$ - occur within the South Coast, San Diego, San Joaquin Valley, San Francisco Bay area, and Sacramento Valley air basins.

APPENDIX A. MONITORING SUMMARY

Table A1. Locations with measured and reconstructed fine mass measurements (174 sites).

Basin	County	Site	Code	Months	Start	End
Great Basin Valleys	Inyo	Coso Junction-Highway 395 Rest Area	2248	79	1993	1999
Great Basin Valleys	Inyo	Keeler-Cerro Gordo Road	3154	88	1995	2002
Great Basin Valleys	Inyo	Lone Pine-E Locust Street	2219	73	1989	1995
Great Basin Valleys	Mono	Mammoth Lakes-Gateway HC	2915	115	1985	2001
Lake County	Lake	Lakeport-Lakeport Blvd	2914	215	1980	2002
Lake Tahoe	El Dorado	Echo Summit	3487	25	2000	2002
Lake Tahoe	El Dorado	South Lake Tahoe-3377 Tahoe Blvd	2405	73	1985	1992
Lake Tahoe	El Dorado	South Lake Tahoe-Sandy Way	2948	68	1993	2002
Lake Tahoe	Placer	Olympic Valley-Squaw Valley	3167	3	1996	1996
Mexico	Mexicali Area	Mexicali-Buen Pastor	3192	4	1996	1996
Mexico	Mexicali Area	Mexicali-CBTIS	3202	35	1997	1999
Mexico	Mexicali Area	Mexicali-Cobach	3203	31	1997	1999
Mexico	Mexicali Area	Mexicali-Conalep	3193	10	1997	1997
Mexico	Mexicali Area	Mexicali-ITM	3185	37	1996	1999
Mexico	Mexicali Area	Mexicali-Museo	3190	3	1996	1996
Mexico	Mexicali Area	Mexicali-Odontolgia	3191	4	1996	1996
Mexico	Mexicali Area	Mexicali-Profepa	3184	4	1996	1996
Mexico	Mexicali Area	Mexicali-Progreso	3204	10	1997	1997
Mexico	Mexicali Area	Mexicali-UABC	3201	35	1997	1999
Mexico	Tijuana Area	Rosarito	3183	43	1996	1999
Mexico	Tijuana Area	Tecate-Paseo Morelos	3255	7	1999	1999
Mexico	Tijuana Area	Tijuana-Center of Health #1	3139	23	1996	1997
Mexico	Tijuana Area	Tijuana-Colef	3214	3	1997	1997
Mexico	Tijuana Area	Tijuana-ITT	3138	40	1995	1999
Mexico	Tijuana Area	Tijuana-La Mesa	3141	48	1996	1999
Mexico	Tijuana Area	Tijuana-Las Playas	3178	46	1996	1999
Mojave Desert	Kern	Mojave-923 Poole Street	3121	47	1999	2002
Mojave Desert	Kern	Ridgecrest-Las Flores Avenue	3122	43	1999	2002
Mojave Desert	Los Angeles	Lancaster	2031	14	1989	1990
Mojave Desert	Los Angeles	Lancaster-43301 Division Street	3658	14	2001	2002
Mojave Desert	Los Angeles	Lancaster-W Pondera Street	3007	123	1990	2001
Mojave Desert	San Bernardino	Barstow	2923	114	1985	1996
Mojave Desert	San Bernardino	Cajon-3 miles NW	2210	2	1981	1981
Mojave Desert	San Bernardino	Hesperia-Olive Street	2650	43	1989	1996
Mojave Desert	San Bernardino	Trona-Market Street	2174	18	1991	1993
Mojave Desert	San Bernardino	Twentynine Palms-Adobe Road	2345	4	1993	1993
Mojave Desert	San Bernardino	Twentynine Palms-Adobe Road #2	3124	18	1994	1996
Mojave Desert	San Bernardino	Victorville-14306 Park Avenue	3500	36	2000	2002
Mojave Desert	San Bernardino	Victorville-Armagosa Road	2963	70	1993	2000
Mountain Counties	Calaveras	San Andreas-Gold Strike Road	3144	48	1999	2002
Mountain Counties	Mariposa	Yosemite Natl Park-Turtleback Dome	3018	70	1988	1995
Mountain Counties	Mariposa	Yosemite Village-Visitor Center	2353	15	1986	1987
Mountain Counties	Nevada	Grass Valley-Litton Building	3126	48	1999	2002

Basin	County	Site	Code	Months	Start	End
Mountain Counties	Nevada	Truckee-Fire Station	2208	45	1999	2002
Mountain Counties	Plumas	Portola-161 Nevada Street	3494	27	2000	2002
Mountain Counties	Plumas	Portola-Commercial Street	3213	23	1997	1999
Mountain Counties	Plumas	Quincy-N Church Street	3020	100	1989	2002
Mountain Counties	Plumas	Quincy-S Redburg Avenue	2139	12	1986	1987
North Central Coast	Monterey	Salinas-#3	3489	36	2000	2002
North Central Coast	Monterey	Salinas-Natividad Road #2	2789	42	1985	1999
North Central Coast	Santa Cruz	Santa Cruz-2544 Soquel Avenue	3200	47	1999	2002
North Coast	Del Norte	Gasquet-Airport	3027	80	1988	1995
North Coast	Humboldt	Eureka-Health Dept 6th and I Street	2386	48	1999	2002
North Coast	Mendocino	Ukiah-County Library	2271	42	1999	2002
North Coast	Mendocino	Willits-Firehouse	2347	3	1985	1986
North Coast	Trinity	Weaverville-Hospital	2387	9	1987	1987
Northeast Plateau	Modoc	Alturas-W 4th Street	2959	37	1999	2002
Northeast Plateau	Siskiyou	Yreka-Foothill Drive	2752	4	1987	1988
Outside of California	Outside Calif	Cave Rock State Park	3482	10	2001	2002
Outside of California	Outside Calif	Incline Village-846 Tahoe Blvd	3481	10	2001	2002
Sacramento Valley	Butte	Chico-Manzanita Avenue	2115	271	1980	2002
Sacramento Valley	Butte	East Biggs	2424	4	1982	1983
Sacramento Valley	Butte	Gridley-Cowee Avenue	2630	119	1984	1994
Sacramento Valley	Colusa	Arbuckle-Hillgate Road	2395	127	1984	1994
Sacramento Valley	Colusa	Colusa-Fairgrounds	2109	171	1980	1994
Sacramento Valley	Colusa	Colusa-Sunrise Blvd	2744	73	1990	2002
Sacramento Valley	Glenn	Willows-E Laurel Street	3137	87	1994	2001
Sacramento Valley	Glenn	Willows-N Villa Avenue	2888	172	1980	1994
Sacramento Valley	Placer	Rocklin-Rocklin Road	3008	9	1996	1998
Sacramento Valley	Placer	Rocklin-Sierra College	2656	19	1986	1988
Sacramento Valley	Placer	Roseville-N Sunrise Blvd	2956	117	1993	2002
Sacramento Valley	Sacramento	Citrus Heights-Sunrise Blvd	2001	160	1980	1993
Sacramento Valley	Sacramento	Elk Grove-Bruceville Road	2977	4	2001	2001
Sacramento Valley	Sacramento	Sacramento-Del Paso Manor	2731	35	1999	2002
Sacramento Valley	Sacramento	Sacramento-Health Dept Stockton Blvd	2346	35	1999	2002
Sacramento Valley	Sacramento	Sacramento-Metro Airport Tower	2688	27	1983	1985
Sacramento Valley	Sacramento	Sacramento-T Street	3011	171	1988	2002
Sacramento Valley	Shasta	Redding-Health Dept Roof	2829	64	1994	2002
Sacramento Valley	Sutter	Pleasant Grove-4 miles SW	2848	149	1982	1994
Sacramento Valley	Sutter	Yuba City-Ag Building	2291	97	1981	1989
Sacramento Valley	Sutter	Yuba City-Almond Street	2958	118	1989	2002
Sacramento Valley	Tehama	Red Bluff-Riverside Drive	2819	47	1994	1999
Sacramento Valley	Yolo	Davis-Golf Course	2238	61	1982	1987
Sacramento Valley	Yolo	Davis-UCD Campus	2143	79	1987	1994
Sacramento Valley	Yolo	Dunnigan-Main Street	2467	2	1980	1980
Sacramento Valley	Yolo	Dunnigan-Rest Area I5 East	2889	28	1982	1984
Sacramento Valley	Yolo	Woodland-Gibson Road	3249	47	1999	2002
Sacramento Valley	Yolo	Woodland-West Main Street	2490	127	1980	1990
Salton Sea	Imperial	Brawley-Main Street	2415	89	1990	2002
Salton Sea	Imperial	Calexico-Ethel Street	3135	101	1994	2002

Basin	County	Site	Code	Months	Start	End
Salton Sea	Imperial	Calexico-Grant Street	2997	50	1991	1997
Salton Sea	Imperial	El Centro-9th Street	2551	172	1988	2002
Salton Sea	Imperial	Westmorland-W 1st Street	3143	2	1996	1996
Salton Sea	Imperial	Winterhaven-2nd Avenue	3142	2	1996	1996
Salton Sea	Riverside	Indio-Jackson Street	2878	46	1999	2002
Salton Sea	Riverside	Palm Springs-Fire Station	2199	182	1987	2002
San Diego	San Diego	Chula Vista	2589	75	1986	2002
San Diego	San Diego	El Cajon-Redwood Avenue	2327	199	1986	2002
San Diego	San Diego	Escondido-E Valley Parkway	2263	48	1999	2002
San Diego	San Diego	Oceanside-Mission Avenue	2897	169	1984	1998
San Diego	San Diego	San Diego-12th Avenue	2964	48	1999	2002
San Diego	San Diego	San Diego-Logan Avenue	3488	17	1999	2001
San Diego	San Diego	San Diego-Overland Avenue	2040	54	1986	2002
San Francisco Bay Area	Alameda	Fremont-Chapel Way	2293	175	1988	2002
San Francisco Bay Area	Alameda	Livermore-793 Rincon Avenue	3490	37	1999	2002
San Francisco Bay Area	Alameda	Livermore-Old 1st Street	2372	162	1986	1999
San Francisco Bay Area	Contra Costa	Bethel Island Road	2804	238	1981	2002
San Francisco Bay Area	Contra Costa	Concord-2975 Treat Blvd	2831	196	1986	2002
San Francisco Bay Area	Contra Costa	Pittsburg-10th Street	2102	38	1999	2002
San Francisco Bay Area	Contra Costa	Richmond-13th Street	2236	92	1989	1997
San Francisco Bay Area	Contra Costa	San Pablo-El Portal	3207	22	1997	2002
San Francisco Bay Area	Contra Costa	San Pablo-Rumrill Blvd	3668	4	2002	2002
San Francisco Bay Area	Marin	San Rafael	2622	194	1986	2002
San Francisco Bay Area	Napa	Napa-Jefferson Avenue	2655	198	1986	2002
San Francisco Bay Area	San Francisco	San Francisco-Arkansas Street	2373	202	1986	2002
San Francisco Bay Area	San Mateo	Redwood City	2125	203	1986	2002
San Francisco Bay Area	Santa Clara	San Jose-4th Street	2413	210	1984	2002
San Francisco Bay Area	Santa Clara	San Jose-Jackson Street	3661	3	2002	2002
San Francisco Bay Area	Santa Clara	San Jose-Tully Road	2936	46	1999	2002
San Francisco Bay Area	Santa Clara	San Jose-W San Carlos Street	3000	67	1989	1995
San Francisco Bay Area	Solano	Vallejo-304 Tuolumne Street	2410	98	1994	2002
San Francisco Bay Area	Sonoma	Santa Rosa-5th Street	2105	97	1994	2002
San Joaquin Valley	Fresno	Clovis-N Villa Avenue	3026	143	1991	2002
San Joaquin Valley	Fresno	Five Points	2617	28	1989	1991
San Joaquin Valley	Fresno	Fresno-1st Street	3009	153	1990	2002
San Joaquin Valley	Fresno	Fresno-Cal State #2	2012	51	1985	1989
San Joaquin Valley	Fresno	Fresno-Hamilton & Winery	3485	36	2000	2002
San Joaquin Valley	Fresno	Fresno-Olive Street	2367	66	1984	1990
San Joaquin Valley	Kern	Bakersfield-410 E Planz Road	3496	35	2000	2002
San Joaquin Valley	Kern	Bakersfield-5055 California Street	2953	5	1992	1992
San Joaquin Valley	Kern	Bakersfield-5558 California Avenue	3146	221	1984	2002
San Joaquin Valley	Kern	Bakersfield-Golden State Highway	3145	49	1996	2002
San Joaquin Valley	Kern	Oildale-3311 Manor Street	2772	187	1986	2002
San Joaquin Valley	Kern	Shafter-Walker Street	2981	22	1993	1994
San Joaquin Valley	Kern	Taft College	3024	109	1990	2000
San Joaquin Valley	Kings	Corcoran-Patterson Avenue	3194	73	1996	2002
San Joaquin Valley	Kings	Corcoran-Van Dorsten Avenue	2638	105	1989	1998

Basin	County	Site	Code	Months	Start	End
San Joaquin Valley	Kings	Kettleman City-CalTrans	2916	58	1988	1996
San Joaquin Valley	Madera	Madera-Health Dept #2	2591	12	1989	1989
San Joaquin Valley	Madera	Madera-Library	2564	75	1990	1996
San Joaquin Valley	Merced	Merced-1st Street	2084	5	1981	1982
San Joaquin Valley	Merced	Merced-2334 M Street	3253	44	1999	2002
San Joaquin Valley	San Joaquin	Stockton-Hazelton Street	2094	253	1981	2002
San Joaquin Valley	Stanislaus	Modesto-14th Street	2833	214	1981	2002
San Joaquin Valley	Stanislaus	Modesto-I Street	2861	100	1990	1998
San Joaquin Valley	Stanislaus	Modesto-Oakdale Road	2280	15	1989	1990
San Joaquin Valley	Tulare	Sequoia Natl Park-Giant Forest	2069	84	1988	1995
San Joaquin Valley	Tulare	Visalia-N Church Street	2032	218	1984	2002
South Central Coast	San Luis Obispo	Arroyo Grande-Ralcoa Way	3030	3	1995	1995
South Central Coast	San Luis Obispo	Atascadero-Lewis Avenue	2965	48	1999	2002
South Central Coast	San Luis Obispo	Paso Robles-Santa Fe Avenue	2955	1	1994	1994
South Central Coast	San Luis Obispo	San Luis Obispo-Marsh Street	2709	181	1987	2002
South Central Coast	Santa Barbara	Goleta	2708	80	1986	1995
South Central Coast	Santa Barbara	Santa Barbara-W Carillo Street	2500	16	1999	2000
South Central Coast	Santa Barbara	Santa Maria-906 S Broadway	3486	17	2000	2001
South Central Coast	Santa Barbara	Santa Maria-Broadway	2161	41	1999	2002
South Central Coast	Ventura	El Rio-Rio Mesa School	2821	44	1988	1991
South Central Coast	Ventura	El Rio-Rio Mesa School #2	2991	163	1988	2002
South Central Coast	Ventura	Piru-3301 Pacific Avenue	3505	26	2000	2002
South Central Coast	Ventura	San Nicolas Island-Building 98	3672	36	1982	1993
South Central Coast	Ventura	Simi Valley-Cochran I	2681	6	1985	1985
South Central Coast	Ventura	Simi Valley-Cochran Street	2880	202	1985	2002
South Central Coast	Ventura	Thousand Oaks-Moorpark Road	2984	48	1999	2002
South Coast	Los Angeles	Avalon-Crescent Avenue	2974	4	1990	1990
South Coast	Los Angeles	Azusa	2484	250	1982	2002
South Coast	Los Angeles	Burbank-W Palm Avenue	2492	230	1982	2002
South Coast	Los Angeles	Diamond Bar-E Copley Drive	3130	12	1995	1996
South Coast	Los Angeles	Hawthorne	2045	186	1982	2002
South Coast	Los Angeles	Los Angeles-North Main Street	2899	236	1982	2002
South Coast	Los Angeles	Lynwood	2583	48	1999	2002
South Coast	Los Angeles	North Long Beach	2429	229	1982	2002
South Coast	Los Angeles	Pasadena-S Wilson Avenue	2160	58	1982	2002
South Coast	Los Angeles	Pico Rivera	2166	48	1999	2002
South Coast	Los Angeles	Reseda	2420	74	1983	2002
South Coast	Los Angeles	Santa Clarita	3502	20	2001	2002
South Coast	Los Angeles	Santa Clarita-County Fire Station	2855	144	1989	2001
South Coast	Los Angeles	Santa Clarita-Honby	2995	9	1989	1990
South Coast	Los Angeles	West Los Angeles-VA Hospital	2494	12	1982	1982
South Coast	Orange	Anaheim-Harbor Blvd	2623	176	1982	2002
South Coast	Orange	El Toro	2603	188	1984	2000
South Coast	Orange	Mission Viejo-26081 Via Pera	3265	43	1999	2002
South Coast	Riverside	Riverside-Magnolia	2333	79	1980	2002
South Coast	Riverside	Riverside-Rubidoux	2596	230	1982	2002
South Coast	Riverside	Temecula-Rancho California Road	3021	22	1991	1993

Basin	County	Site	Code	Months	Start	End
South Coast	San Bernardino	Big Bear City-501 W. Valley Blvd	3266	47	1999	2002
South Coast	San Bernardino	Fontana-Arrow Highway	2266	128	1985	2002
South Coast	San Bernardino	Ontario-1408 Francis Street	3254	48	1999	2002
South Coast	San Bernardino	San Bernardino-4th Street	2221	198	1986	2002
South Coast	San Bernardino	Upland	2485	127	1980	1990

Table A2. Locations with at least 60 months of measured and reconstructed fine mass measurements (66 sites).

Basin	County	Site	Code	Months	Start	End
Great Basin Valleys	Inyo	Coso Junction-Highway 395 Rest Area	2248	79	1993	1999
Great Basin Valleys	Inyo	Keeler-Cerro Gordo Road	3154	88	1995	2002
Great Basin Valleys	Inyo	Lone Pine-E Locust Street	2219	73	1989	1995
Great Basin Valleys	Mono	Mammoth Lakes-Gateway HC	2915	115	1985	2001
Lake County	Lake	Lakeport-Lakeport Blvd	2914	215	1980	2002
Lake Tahoe	El Dorado	South Lake Tahoe-3377 Tahoe Blvd	2405	73	1985	1992
Lake Tahoe	El Dorado	South Lake Tahoe-Sandy Way	2948	68	1993	2002
Mojave Desert	Los Angeles	Lancaster-W Pondera Street	3007	123	1990	2001
Mojave Desert	San Bernardino	Barstow	2923	114	1985	1996
Mojave Desert	San Bernardino	Victorville-Armagosa Road	2963	70	1993	2000
Mountain Counties	Mariposa	Yosemite Natl Park-Turtleback Dome	3018	70	1988	1995
Mountain Counties	Plumas	Quincy-N Church Street	3020	100	1989	2002
North Coast	Del Norte	Gasquet-Airport	3027	80	1988	1995
Sacramento Valley	Butte	Chico-Manzanita Avenue	2115	271	1980	2002
Sacramento Valley	Butte	Gridley-Cowee Avenue	2630	119	1984	1994
Sacramento Valley	Colusa	Arbuckle-Hillgate Road	2395	127	1984	1994
Sacramento Valley	Colusa	Colusa-Fairgrounds	2109	171	1980	1994
Sacramento Valley	Colusa	Colusa-Sunrise Blvd	2744	73	1990	2002
Sacramento Valley	Glenn	Willows-E Laurel Street	3137	87	1994	2001
Sacramento Valley	Glenn	Willows-N Villa Avenue	2888	172	1980	1994
Sacramento Valley	Placer	Roseville-N Sunrise Blvd	2956	117	1993	2002
Sacramento Valley	Sacramento	Citrus Heights-Sunrise Blvd	2001	160	1980	1993
Sacramento Valley	Sacramento	Sacramento-T Street	3011	171	1988	2002
Sacramento Valley	Shasta	Redding-Health Dept Roof	2829	64	1994	2002
Sacramento Valley	Sutter	Pleasant Grove-4 miles SW	2848	149	1982	1994
Sacramento Valley	Sutter	Yuba City-Ag Building	2291	97	1981	1989
Sacramento Valley	Sutter	Yuba City-Almond Street	2958	118	1989	2002
Sacramento Valley	Yolo	Davis-Golf Course	2238	61	1982	1987
Sacramento Valley	Yolo	Davis-UCD Campus	2143	79	1987	1994
Sacramento Valley	Yolo	Woodland-West Main Street	2490	127	1980	1990
Salton Sea	Imperial	Brawley-Main Street	2415	89	1990	2002
Salton Sea	Imperial	Calexico-Ethel Street	3135	101	1994	2002
Salton Sea	Imperial	El Centro-9th Street	2551	172	1988	2002
Salton Sea	Riverside	Palm Springs-Fire Station	2199	182	1987	2002
San Diego	San Diego	Chula Vista	2589	75	1986	2002
San Diego	San Diego	El Cajon-Redwood Avenue	2327	199	1986	2002
San Diego	San Diego	Oceanside-Mission Avenue	2897	169	1984	1998
San Francisco Bay Area	Alameda	Fremont-Chapel Way	2293	175	1988	2002
San Francisco Bay Area	Alameda	Livermore-Old 1st Street	2372	162	1986	1999
San Francisco Bay Area	Contra Costa	Bethel Island Road	2804	238	1981	2002
San Francisco Bay Area	Contra Costa	Concord-2975 Treat Blvd	2831	196	1986	2002
San Francisco Bay Area	Contra Costa	Richmond-13th Street	2236	92	1989	1997
San Francisco Bay Area	Marin	San Rafael	2622	194	1986	2002
San Francisco Bay Area	Napa	Napa-Jefferson Avenue	2655	198	1986	2002
San Francisco Bay Area	San Francisco	San Francisco-Arkansas Street	2373	202	1986	2002

Basin	County	Site	Code	Months	Start	End
San Francisco Bay Area	San Mateo	Redwood City	2125	203	1986	2002
San Francisco Bay Area	Santa Clara	San Jose-4th Street	2413	210	1984	2002
San Francisco Bay Area	Santa Clara	San Jose-W San Carlos Street	3000	67	1989	1995
San Francisco Bay Area	Solano	Vallejo-304 Tuolumne Street	2410	98	1994	2002
San Francisco Bay Area	Sonoma	Santa Rosa-5th Street	2105	97	1994	2002
San Joaquin Valley	Fresno	Clovis-N Villa Avenue	3026	143	1991	2002
San Joaquin Valley	Fresno	Fresno-1st Street	3009	153	1990	2002
San Joaquin Valley	Fresno	Fresno-Olive Street	2367	66	1984	1990
San Joaquin Valley	Kern	Bakersfield-5558 California Avenue	3146	221	1984	2002
San Joaquin Valley	Kern	Oildale-3311 Manor Street	2772	187	1986	2002
San Joaquin Valley	Kern	Taft College	3024	109	1990	2000
San Joaquin Valley	Kings	Corcoran-Patterson Avenue	3194	73	1996	2002
San Joaquin Valley	Kings	Corcoran-Van Dorsten Avenue	2638	105	1989	1998
San Joaquin Valley	Madera	Madera-Library	2564	75	1990	1996
San Joaquin Valley	San Joaquin	Stockton-Hazelton Street	2094	253	1981	2002
San Joaquin Valley	Stanislaus	Modesto-14th Street	2833	214	1981	2002
San Joaquin Valley	Stanislaus	Modesto-I Street	2861	100	1990	1998
San Joaquin Valley	Tulare	Sequoia Natl Park-Giant Forest	2069	84	1988	1995
San Joaquin Valley	Tulare	Visalia-N Church Street	2032	218	1984	2002
South Central Coast	San Luis Obispo	San Luis Obispo-Marsh Street	2709	181	1987	2002
South Central Coast	Santa Barbara	Goleta	2708	80	1986	1995
South Central Coast	Ventura	El Rio-Rio Mesa School #2	2991	163	1988	2002
South Central Coast	Ventura	Simi Valley-Cochran Street	2880	202	1985	2002
South Coast	Los Angeles	Azusa	2484	250	1982	2002
South Coast	Los Angeles	Burbank-W Palm Avenue	2492	230	1982	2002
South Coast	Los Angeles	Hawthorne	2045	186	1982	2002
South Coast	Los Angeles	Los Angeles-North Main Street	2899	236	1982	2002
South Coast	Los Angeles	North Long Beach	2429	229	1982	2002
South Coast	Los Angeles	Reseda	2420	74	1983	2002
South Coast	Los Angeles	Santa Clarita-County Fire Station	2855	144	1989	2001
South Coast	Orange	Anaheim-Harbor Blvd	2623	176	1982	2002
South Coast	Orange	El Toro	2603	188	1984	2000
South Coast	Riverside	Riverside-Magnolia	2333	79	1980	2002
South Coast	Riverside	Riverside-Rubidoux	2596	230	1982	2002
South Coast	San Bernardino	Fontana-Arrow Highway	2266	128	1985	2002
South Coast	San Bernardino	San Bernardino-4th Street	2221	198	1986	2002
South Coast	San Bernardino	Upland	2485	127	1980	1990

Table A3. Sites with measured or reconstructed monthly-average $PM_{2.5}$ mass concentrations compared with sites having speciated PM data from the Speciated Trends Network (STN) database.

Basin	County	Site	Code	AIRS	Predicted PM2.5	PM-STN
Great Basin Valleys	Inyo	Lone Pine-E Locust Street	2219	60270004	yes	
Great Basin Valleys	Inyo	Coso Junction-Highway 395 Rest Area	2248	60271001	yes	
Great Basin Valleys	Mono	Mammoth Lakes-Gateway HC	2915	60510001	yes	
Great Basin Valleys	Inyo	Keeler-Cerro Gordo Road	3154	60271003	yes	
Lake County	Lake	Lakeport-Lakeport Blvd	2914	60333001	yes	
Lake Tahoe	El Dorado	South Lake Tahoe-3377 Tahoe Blvd	2405	60170009	yes	
Lake Tahoe	El Dorado	South Lake Tahoe-Sandy Way	2948	60170011	yes	yes
Lake Tahoe	Placer	Olympic Valley-Squaw Valley	3167	60611005	yes	
Lake Tahoe	El Dorado	Echo Summit	3487	60170012	yes	yes
Mexico	Tijuana Area	Tijuana-ITT	3138	800020001	yes	
Mexico	Tijuana Area	Tijuana-Center of Health #1	3139	800020002	yes	
Mexico	Tijuana Area	Tijuana-La Mesa	3141	800020003	yes	
Mexico	Tijuana Area	Tijuana-Las Playas	3178	800020005	yes	
Mexico	Tijuana Area	Rosarito	3183	800020004	yes	
Mexico	Mexicali Area	Mexicali-Profepa	3184	800020008	yes	
Mexico	Mexicali Area	Mexicali-ITM	3185	800020010	yes	
Mexico	Mexicali Area	Mexicali-Museo	3190	800020006	yes	
Mexico	Mexicali Area	Mexicali-Odontolgia	3191	800020007	yes	
Mexico	Mexicali Area	Mexicali-Buen Pastor	3192	800020009	yes	
Mexico	Mexicali Area	Mexicali-Conalep	3193	800020011	yes	
Mexico	Mexicali Area	Mexicali-UABC	3201	800020012	yes	
Mexico	Mexicali Area	Mexicali-CBTIS	3202	800020013	yes	
Mexico	Mexicali Area	Mexicali-Cobach	3203	800020014	yes	
Mexico	Mexicali Area	Mexicali-Progreso	3204	800020015	yes	
Mexico	Tijuana Area	Tijuana-Colef	3214	800020016	yes	
Mexico	Tijuana Area	Tecate-Paseo Morelos	3255	800020017	yes	
Mojave Desert	Los Angeles	Lancaster	2031	60377001	yes	
Mojave Desert	San Bernardino	Trona-Market Street	2174	60710006	yes	
Mojave Desert	San Bernardino	Cajon-3 miles NW	2210	60710009	yes	
Mojave Desert	San Bernardino	Twentynine Palms-Adobe Road	2345	60711101	yes	
Mojave Desert	San Bernardino	Hesperia-Olive Street	2650	60714001	yes	
Mojave Desert	San Bernardino	Barstow	2923	60710001	yes	
Mojave Desert	San Bernardino	Victorville-Armagosa Road	2963	60710014	yes	
Mojave Desert	Los Angeles	Lancaster-W Pondera Street	3007	60379002	yes	
Mojave Desert	Kern	Mojave-923 Poole Street	3121	60290011	yes	
Mojave Desert	Kern	Ridgecrest-Las Flores Avenue	3122	60290012	yes	

Basin	County	Site	Code	AIRS	Predicted PM2.5	PM-STN
Mojave Desert	San Bernardino	Twentynine Palms-Adobe Road #2	3124	60710017	yes	
Mojave Desert	San Bernardino	Victorville-14306 Park Avenue	3500	60710306	yes	
Mojave Desert	Los Angeles	Lancaster-43301 Division Street	3658	60379033	yes	
Mountain Counties	Plumas	Quincy-S Redburg Avenue	2139		yes	
Mountain Counties	Nevada	Truckee-Fire Station	2208	60571001	yes	
Mountain Counties	Mariposa	Yosemite Village-Visitor Center	2353	60431001	yes	
Mountain Counties	Mariposa	Yosemite Natl Park-Turtleback Dome	3018	60430003	yes	
Mountain Counties	Plumas	Quincy-N Church Street	3020	60631006	yes	
Mountain Counties	Nevada	Grass Valley-Litton Building	3126	60570005	yes	
Mountain Counties	Calaveras	San Andreas-Gold Strike Road	3144	60090001	yes	yes
Mountain Counties	Plumas	Portola-Commercial Street	3213	60631008	yes	
Mountain Counties	Plumas	Portola-161 Nevada Street	3494	60631009	yes	
North Central Coast	Monterey	Salinas-Natividad Road #2	2789	60531002	yes	
North Central Coast	Santa Cruz	Santa Cruz-2544 Soquel Avenue	3200	60870007	yes	
North Central Coast	Monterey	Salinas-#3	3489	60531003	yes	
North Coast	Mendocino	Ukiah-County Library	2271	60450006	yes	
North Coast	Mendocino	Willits-Firehouse	2347	60452001	yes	
North Coast	Humboldt	Eureka-Health Dept 6th and I Street	2386	60231002	yes	yes
North Coast	Trinity	Weaverville-Hospital	2387	61050001	yes	
North Coast	Del Norte	Gasquet-Airport	3027	60150003	yes	
Northeast Plateau	Siskiyou	Yreka-Foothill Drive	2752	60932001	yes	
Northeast Plateau	Modoc	Alturas-W 4th Street	2959	60490001	yes	
Outside of California	Outside Calif	Incline Village-846 Tahoe Blvd	3481	320312002	yes	
Outside of California	Outside Calif	Cave Rock State Park	3482	320050008	yes	
Sacramento Valley	El Dorado	Riverton		60172003		yes
Sacramento Valley	Sacramento	Citrus Heights-Sunrise Blvd	2001	60670001	yes	
Sacramento Valley	Colusa	Colusa-Fairgrounds	2109	60110002	yes	
Sacramento Valley	Butte	Chico-Manzanita Avenue	2115	60070002	yes	yes
Sacramento Valley	Yolo	Davis-UCD Campus	2143	61130004	yes	
Sacramento Valley	Yolo	Davis-Golf Course	2238	61130003	yes	
Sacramento Valley	Sutter	Yuba City-Ag Building	2291	61011002	yes	
Sacramento Valley	Sacramento	Sacramento-Health Dept Stockton Blvd	2346	60674001	yes	
Sacramento Valley	Colusa	Arbuckle-Hillgate Road	2395	60111001	yes	
Sacramento Valley	Butte	East Biggs	2424		yes	
Sacramento Valley	Yolo	Dunnigan-Main Street	2467	61134001	yes	
Sacramento Valley	Yolo	Woodland-West Main Street	2490	61131002	yes	
Sacramento Valley	Butte	Gridley-Cowee Avenue	2630	60074001	yes	yes
Sacramento Valley	Placer	Rocklin-Sierra College	2656	60610810	yes	

Basin	County	Site	Code	AIRS	Predicted PM2.5	PM-STN
Sacramento Valley	Sacramento	Sacramento-Metro Airport Tower	2688		yes	
Sacramento Valley	Sacramento	Sacramento-Del Paso Manor	2731	60670006	yes	
Sacramento Valley	Colusa	Colusa-Sunrise Blvd	2744	60111002	yes	yes
Sacramento Valley	Tehama	Red Bluff-Riverside Drive	2819	61030002	yes	
Sacramento Valley	Shasta	Redding-Health Dept Roof	2829	60890004	yes	
Sacramento Valley	Sutter	Pleasant Grove-4 miles SW	2848	61010002	yes	
Sacramento Valley	Glenn	Willows-N Villa Avenue	2888	60210001	yes	
Sacramento Valley	Yolo	Dunnigan-Rest Area I5 East	2889		yes	
Sacramento Valley	Placer	Roseville-N Sunrise Blvd	2956	60610006	yes	
Sacramento Valley	Sutter	Yuba City-Almond Street	2958	61010003	yes	
Sacramento Valley	Sacramento	Elk Grove-Bruceville Road	2977	60670011	yes	
Sacramento Valley	Placer	Rocklin-Rocklin Road	3008	60613001	yes	
Sacramento Valley	Sacramento	Sacramento-T Street	3011	60670010	yes	
Sacramento Valley	Glenn	Willows-E Laurel Street	3137	60210002	yes	yes
Sacramento Valley	Yolo	Woodland-Gibson Road	3249	61131003	yes	
Salton Sea	Imperial	Brawley-Main Street		60250007		yes
Salton Sea	Riverside	Palm Springs-Fire Station	2199	60655001	yes	
Salton Sea	Imperial	Brawley-Main Street	2415	60250003	yes	yes
Salton Sea	Imperial	El Centro-9th Street	2551	60251003	yes	yes
Salton Sea	Riverside	Indio-Jackson Street	2878	60652002	yes	
Salton Sea	Imperial	Calexico-Grant Street	2997	60250004	yes	
Salton Sea	Imperial	Calexico-Ethel Street	3135	60250005	yes	yes
Salton Sea	Imperial	Winterhaven-2nd Avenue	3142	60254002	yes	
Salton Sea	Imperial	Westmorland-W 1st Street	3143	60254003	yes	
Salton Sea	Imperial	Calexico-East	3173	60250006		yes
San Diego	San Diego	San Diego-Overland Avenue	2040	60730006	yes	
San Diego	San Diego	Escondido-E Valley Parkway	2263	60731002	yes	
San Diego	San Diego	El Cajon-Redwood Avenue	2327	60730003	yes	
San Diego	San Diego	Alpine-Victoria Drive	2460	60731006	yes	
San Diego	San Diego	Chula Vista	2589	60730001	yes	
San Diego	San Diego	Oceanside-Mission Avenue	2897	60730005	yes	
San Diego	San Diego	San Diego-12th Avenue	2964	60731007	yes	
San Diego	San Diego	San Diego-Logan Avenue	3488	60731009	yes	
San Francisco Bay Area	Contra Costa	Pittsburg-10th Street	2102	60133001	yes	
San Francisco Bay Area	Sonoma	Santa Rosa-5th Street	2105	60970003	yes	
San Francisco Bay Area	San Mateo	Redwood City	2125	60811001	yes	
San Francisco Bay Area	Contra Costa	Richmond-13th Street	2236	60130003	yes	
San Francisco Bay Area	Alameda	Fremont-Chapel Way	2293	60011001	yes	yes
San Francisco Bay Area	Alameda	Livermore-Old 1st Street	2372	60010003	yes	
San Francisco Bay Area	San Francisco	San Francisco-Arkansas Street	2373	60750005	yes	

Basin	County	Site	Code	AIRS	Predicted PM2.5	PM-STN
San Francisco Bay Area	Solano	Vallejo-304 Tuolumne Street	2410	60950004	yes	
San Francisco Bay Area	Santa Clara	San Jose-4th Street	2413	60850004	yes	
San Francisco Bay Area	Marin	San Rafael	2622	60410001	yes	
San Francisco Bay Area	Napa	Napa-Jefferson Avenue	2655	60550003	yes	
San Francisco Bay Area	Contra Costa	Bethel Island Road	2804	60131002	yes	
San Francisco Bay Area	Contra Costa	Concord-2975 Treat Blvd	2831	60130002	yes	yes
San Francisco Bay Area	Santa Clara	San Jose-Tully Road	2936	60852003	yes	
San Francisco Bay Area	Santa Clara	San Jose-W San Carlos Street	3000	60852004	yes	
San Francisco Bay Area	Contra Costa	San Pablo-El Portal	3207	60131003	yes	
San Francisco Bay Area	Alameda	Livermore-793 Rincon Avenue	3490	60010007	yes	yes
San Francisco Bay Area	Alameda	Oakland-6701 International Boulevard	3659	60010010		yes
San Francisco Bay Area	Contra Costa	Crockett-1098 Pomona Street	3660	60130010		yes
San Francisco Bay Area	Santa Clara	San Jose-Jackson Street	3661	60850005	yes	
San Francisco Bay Area	Contra Costa	San Pablo-Rumrill Blvd	3668	60131004	yes	
San Joaquin Valley	Fresno	Fresno-Weldon Ave		60190243		yes
San Joaquin Valley	Fresno	Fresno-Mobile		60190244		yes
San Joaquin Valley	Fresno	Fresno-Cal State #2	2012	60190241	yes	
San Joaquin Valley	Tulare	Visalia-N Church Street	2032	61072002	yes	
San Joaquin Valley	Tulare	Sequoia Natl Park-Giant Forest	2069	61070002	yes	
San Joaquin Valley	Merced	Merced-1st Street	2084	60471002	yes	
San Joaquin Valley	San Joaquin	Stockton-Hazelton Street	2094	60771002	yes	
San Joaquin Valley	Stanislaus	Modesto-Oakdale Road	2280	60990003	yes	
San Joaquin Valley	Fresno	Fresno-Olive Street	2367	60190005	yes	
San Joaquin Valley	Madera	Madera-Library	2564	60390001	yes	
San Joaquin Valley	Madera	Madera-Health Dept #2	2591	60390002	yes	
San Joaquin Valley	Fresno	Five Points	2617	60191002	yes	
San Joaquin Valley	Kings	Corcoran-Van Dorsten Avenue	2638	60310003	yes	
San Joaquin Valley	Kern	Oildale-3311 Manor Street	2772	60290232	yes	
San Joaquin Valley	Stanislaus	Modesto-14th Street	2833	60990005	yes	
San Joaquin Valley	Stanislaus	Modesto-I Street	2861	60990002	yes	
San Joaquin Valley	Kings	Kettleman City-CalTrans	2916	60311003	yes	
San Joaquin Valley	Kern	Bakersfield-5055 California Street	2953	60290009	yes	
San Joaquin Valley	Kern	Shafter-Walker Street	2981	60296001	yes	
San Joaquin Valley	Fresno	Fresno-1st Street	3009	60190008	yes	yes
San Joaquin Valley	Kern	Taft College	3024	60292004	yes	

Basin	County	Site	Code	AIRS	Predicted PM2.5	PM-STN
San Joaquin Valley	Fresno	Clovis-N Villa Avenue	3026	60195001	yes	yes
San Joaquin Valley	Kern	Bakersfield-Golden State Highway	3145	60290010	yes	
San Joaquin Valley	Kern	Bakersfield-5558 California Avenue	3146	60290014	yes	
San Joaquin Valley	Kings	Corcoran-Patterson Avenue	3194	60310004	yes	
San Joaquin Valley	Merced	Merced-2334 M Street	3253	60472510	yes	
San Joaquin Valley	Fresno	Fresno-Hamilton & Winery	3485	60195025	yes	yes
San Joaquin Valley	Kern	Bakersfield-410 E Planz Road	3496	60290016	yes	
South Central Coast	Santa Barbara	Santa Maria-Broadway	2161	60831007	yes	
South Central Coast	Santa Barbara	Santa Barbara-W Carillo Street	2500	60830010	yes	
South Central Coast	Ventura	Simi Valley-Cochran I	2681	61117001	yes	
South Central Coast	Santa Barbara	Goleta	2708	60832002	yes	
South Central Coast	San Luis Obispo	San Luis Obispo-Marsh Street	2709	60792002	yes	
South Central Coast	Ventura	El Rio-Rio Mesa School	2821		yes	
South Central Coast	Ventura	Simi Valley-Cochran Street	2880	61112002	yes	
South Central Coast	San Luis Obispo	Paso Robles-Santa Fe Avenue	2955	60790005	yes	
South Central Coast	San Luis Obispo	Atascadero-Lewis Avenue	2965	60798001	yes	
South Central Coast	Ventura	Thousand Oaks-Moorpark Road	2984	61110007	yes	
South Central Coast	Ventura	El Rio-Rio Mesa School #2	2991	61113001	yes	
South Central Coast	San Luis Obispo	Arroyo Grande-Ralcoa Way	3030	60791005	yes	
South Central Coast	Santa Barbara	Santa Maria-906 S Broadway	3486	60831008	yes	
South Central Coast	Ventura	Piru-3301 Pacific Avenue	3505	61110009	yes	
South Central Coast	Ventura	San Nicolas Island-Building 98	3672	61110010	yes	
South Coast	Los Angeles	Hawthorne	2045	60375001	yes	
South Coast	Los Angeles	Pasadena-S Wilson Avenue	2160	60372005	yes	
South Coast	Los Angeles	Pico Rivera	2166	60371601	yes	
South Coast	Riverside	Riverside-UCR Weather Shack	2211	60650005	yes	
South Coast	San Bernardino	San Bernardino-4th Street	2221	60719004	yes	
South Coast	San Bernardino	Fontana-Arrow Highway	2266	60712002	yes	
South Coast	Riverside	Riverside-Magnolia	2333	60651003	yes	
South Coast	Los Angeles	Reseda	2420	60371201	yes	

Basin	County	Site	Code	AIRS	Predicted PM2.5	PM-STN
South Coast	Los Angeles	North Long Beach	2429	60374002	yes	
South Coast	Los Angeles	Azusa	2484	60370002	yes	
South Coast	San Bernardino	Upland	2485	60711004	yes	
South Coast	Los Angeles	Burbank-W Palm Avenue	2492	60371002	yes	
South Coast	Los Angeles	West Los Angeles-VA Hospital	2494	60370113	yes	
South Coast	Los Angeles	Lynwood	2583	60371301	yes	
South Coast	Riverside	Riverside-Rubidoux	2596	60658001	yes	
South Coast	Orange	El Toro	2603	60592001	yes	
South Coast	Orange	Anaheim-Harbor Blvd	2623	60590001	yes	
South Coast	Los Angeles	Glendora-Laurel	2849	60370016	yes	
South Coast	Los Angeles	Santa Clarita-County Fire Station	2855	60376002	yes	
South Coast	Los Angeles	Los Angeles-North Main Street	2899	60371103	yes	
South Coast	Riverside	Lake Elsinore-W Flint Street	2943	60659001	yes	
South Coast	Los Angeles	Avalon-Crescent Avenue	2974	60370019	yes	
South Coast	Los Angeles	Santa Clarita-Honby	2995	60374101	yes	
South Coast	Riverside	Temecula-Rancho California Road	3021	60650006	yes	
South Coast	Los Angeles	Diamond Bar-E Copley Drive	3130	60370206	yes	
South Coast	San Bernardino	Ontario-1408 Francis Street	3254	60710025	yes	
South Coast	Orange	Mission Viejo-26081 Via Pera	3265	60592022	yes	
South Coast	San Bernardino	Big Bear City-501 W. Valley Blvd	3266	60718001	yes	
South Coast	Los Angeles	Santa Clarita	3502	60376012	yes	

APPENDIX B. UNCERTAINTIES OF MONTHLY AVERAGES

Calculation of Estimated Uncertainties

The principal sources of uncertainty in the monthly average PM concentrations are:

1. Sampling, which includes accuracy, precision, variability, and number of days sampled;
2. Conversion, which is determined from the quality of regressions of measured FRM fine mass against other mass measurements or against the measurements that are used for reconstructing fine mass.

Because the averages were computed by month, variations due to seasonal effects are implicitly minimal (but would still be incorporated within the sampling uncertainty). We estimated the uncertainty of each monthly average PM mass concentration as:

B1. $SE = SQRT[(1/n)*(SD^2 + \text{Mean Prediction } S^2)]$

Here, "SD" refers to the standard deviation of the daily-average PM values and "n" is the number of daily averages in a month. A "Prediction S^2" was determined for each predicted daily PM concentration from regressions of the FRM fine mass against other mass measurements (Kokoska and Nevison, 1989):

B2. $\text{Prediction } S^2 = s^2 * [\ 1 + (1/m) + \{\ (x - \bar{X}^2) / S_{XX}\}\ ]$

For each day, the prediction S^2 is the uncertainty of the predicted daily-average FRM mass ("y") given another daily mass measurement ("x", the predictor). The other terms in the equation are "s", the regression mean square error, "m", the number of days of data in the regression, "$\bar{X}$", the mean predictor mass measurement, and S_{XX}, the sum of square of the predictor mass measurements "x." These terms are defined as:

B3. $s = \{\ (m-2)^{-1} * \Sigma\ (y_i - \hat{y}_i)^2\ \}^{1/2}$

$S_{xx} = \Sigma\ (x_i - \bar{X})^2$

$\hat{y}_i = \text{regression intercept} + \text{regression slope} * x_i$

If the term "1" were excluded from the Equation B2, the result would be the usual confidence envelope of a line. A confidence envelope expresses the uncertainty of the mean, whereas the prediction S^2 gives the uncertainty of each individual daily value.

Statistical Summary of Estimated Uncertainties

The estimated uncertainties of any particular measured or reconstructed monthly-average fine PM mass concentration varied depending upon:

- The number of days sampled during the month (Equation B1);
- The reproducibility of FRM fine mass concentrations from the measured or reconstructed PM values (Equations B1 through B3);
- Mean concentrations.

The median standard errors associated with 5 sampling days were approximately twice as large as those associated with 30 sampling days (Figure B1) (note that the square root of 30/5 is 2.4). Some of the variation in the standard errors shown in Figure B1 is associated with differential variability of different types of measurements. Nonetheless, when measurements of a single type are used for forming monthly averages, the standard errors typically declined as the number of sampling days per month increased (Figure B2). In contrast, the distributions of predicted monthly averages did not depend upon the number of sampling days per month (Figure B3).

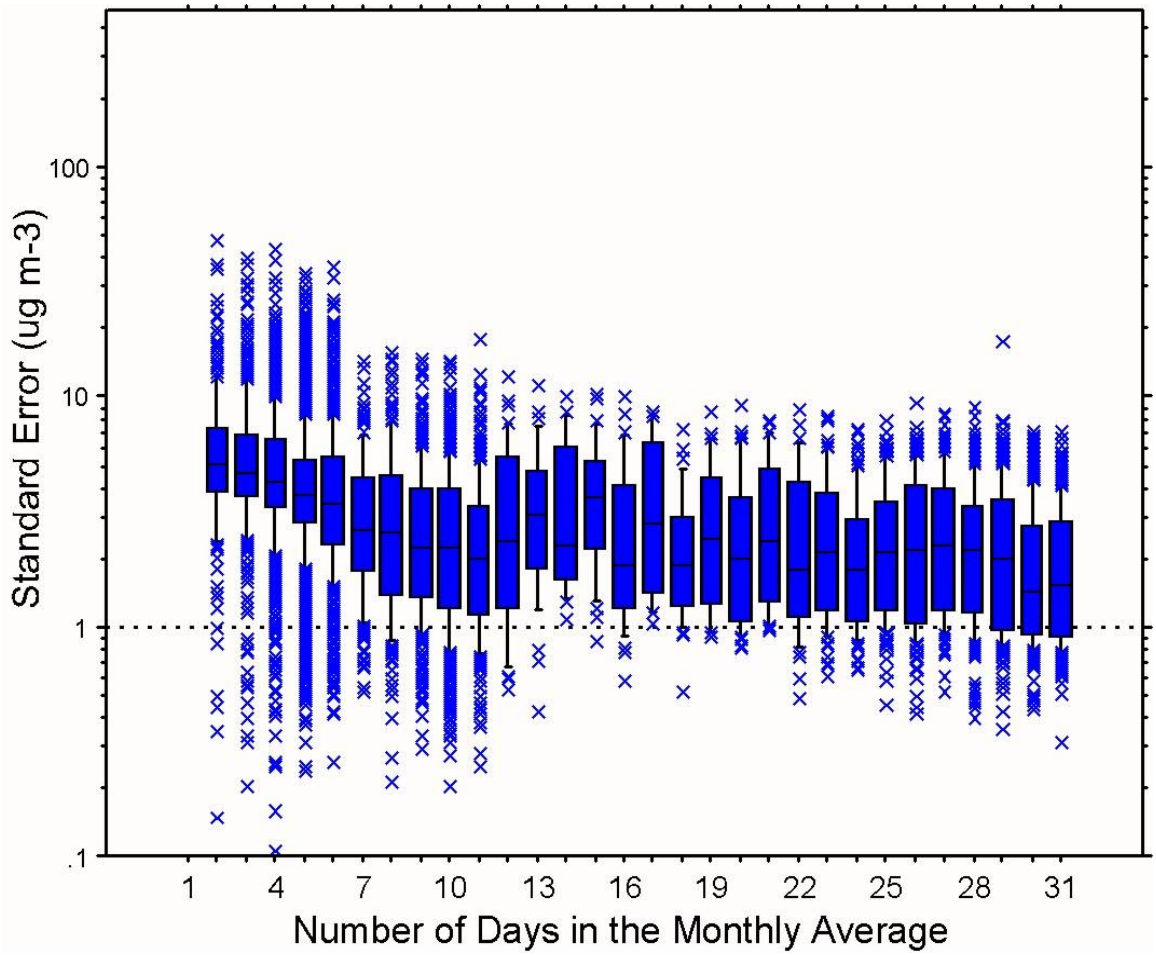

Figure B1. Statistical distributions of the standard error of monthly average PM mass concentration versus the number of sampling days in a month. The monthly averages consist of the best estimates for each site and month using all measurement types. Standard errors were calculated for each individual site and month. The figure shows results for all sites and all months. The box-and-whiskers plots denote the 10th, 25th, 50th, 75th, and 90th percentiles.

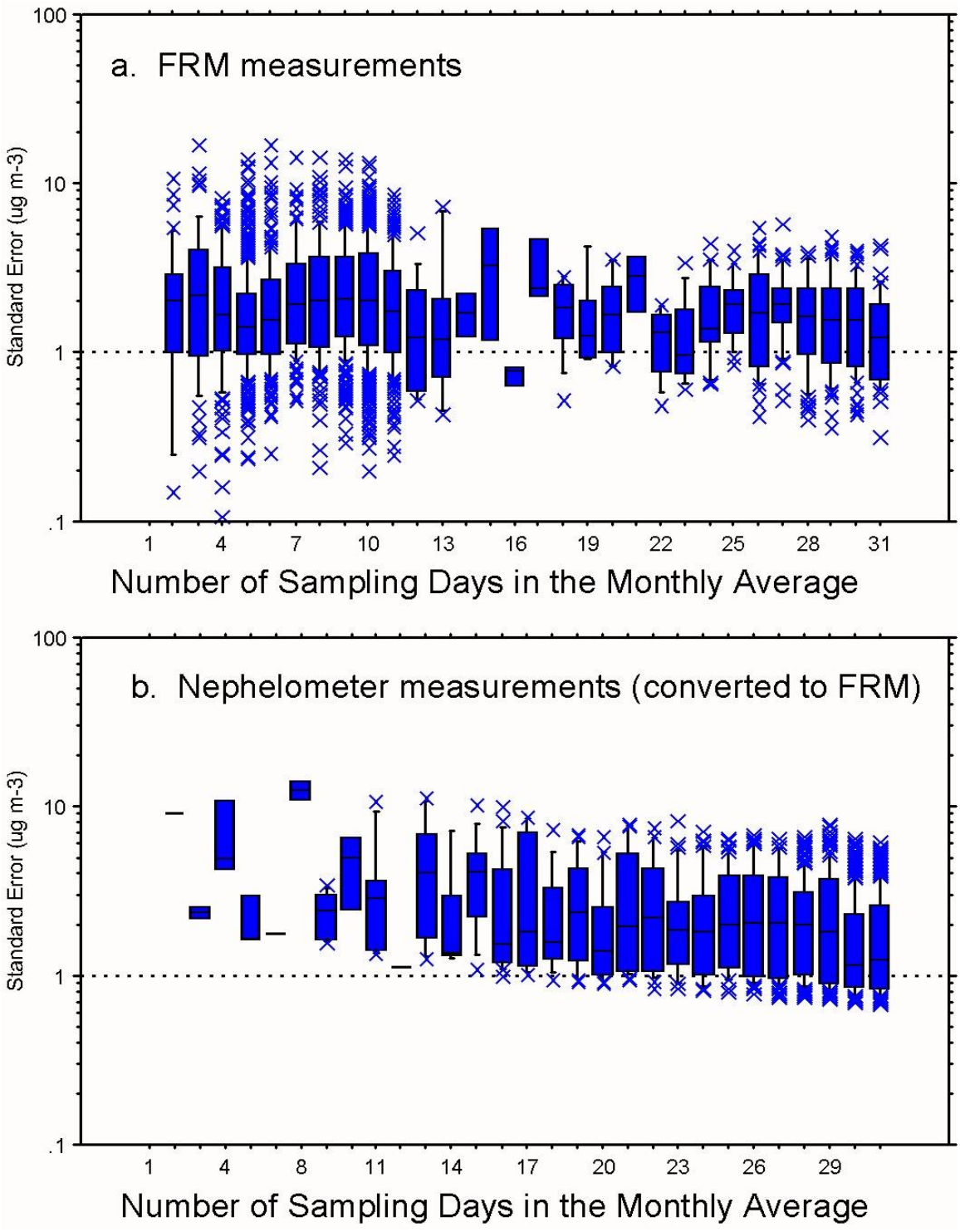

Figure B2. Statistical distributions of the standard error of monthly average (a) FRM PM mass concentration versus the number of sampling days in a month and (b) nepehlometer measurements converted to FRM PM mass concentration versus the number of sampling days in a month. Standard errors were calculated for each individual site and month. The figure shows results for all sites and all months. The box-and-whiskers plots denote the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles.

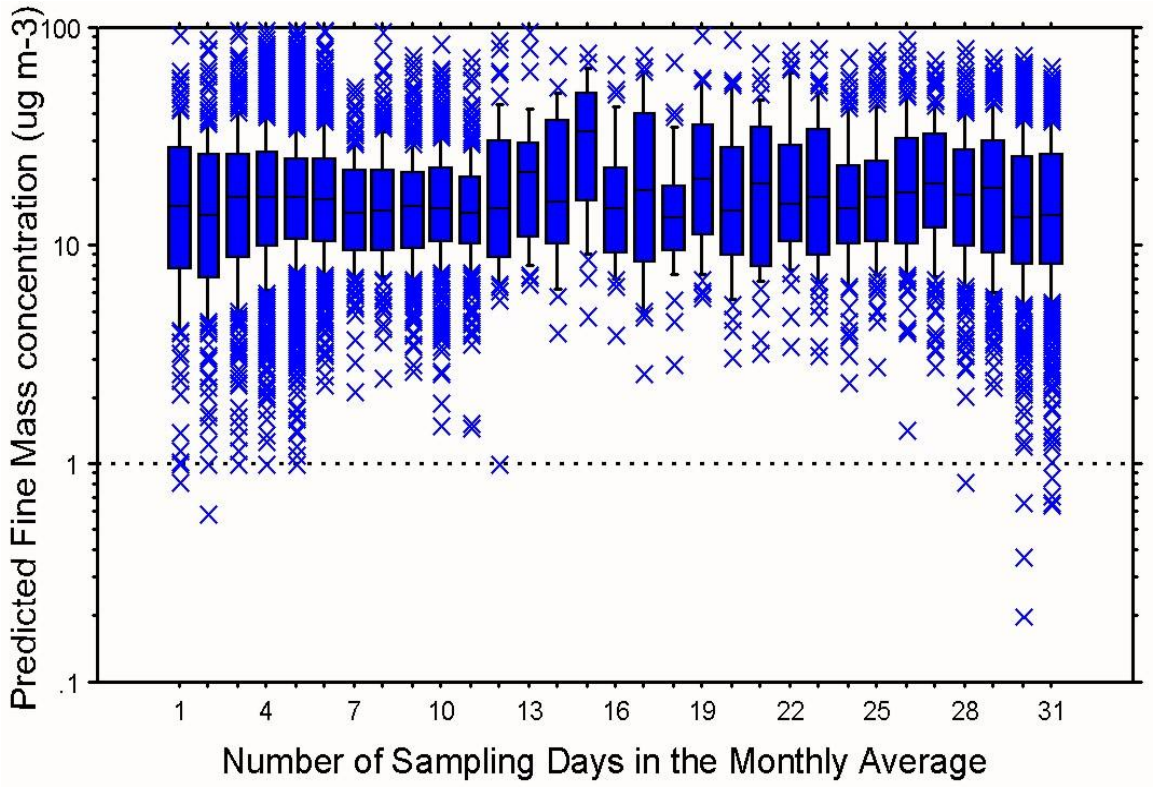

Figure B3. Statistical distributions of the predicted monthly average PM mass concentration versus the number of sampling days in a month. The monthly averages consist of the best estimates for each site and month using all measurement types. The figure shows results for all sites and all months. The box-and-whiskers plots denote the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles.

The uncertainties of the estimated monthly averages varied by month, or season (Figure B4). This variation is due, in part, to the dependence of uncertainties on concentrations (Figure B5), which tend to increase during winter months. The increase of uncertainty as a function of concentrations appears to be related to the distributions of the concentrations, since the overall distribution of the monthly-average fine mass concentrations was more nearly lognormal than normal.

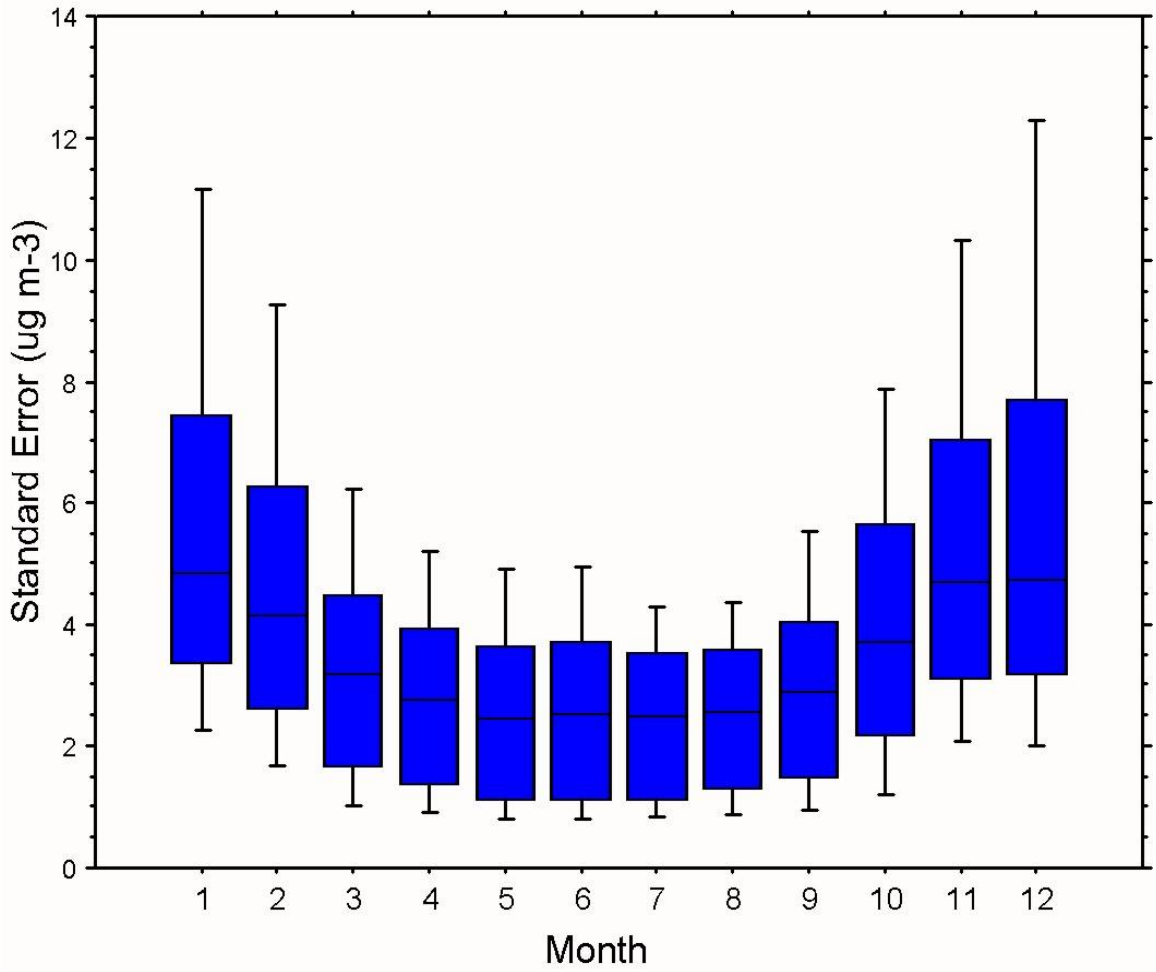

Figure B4. Statistical distributions of the standard error of monthly average PM mass concentration versus month. The data include all sites and all months. The box-and-whiskers plots denote the 10th, 25th, 50th, 75th, and 90th percentiles.

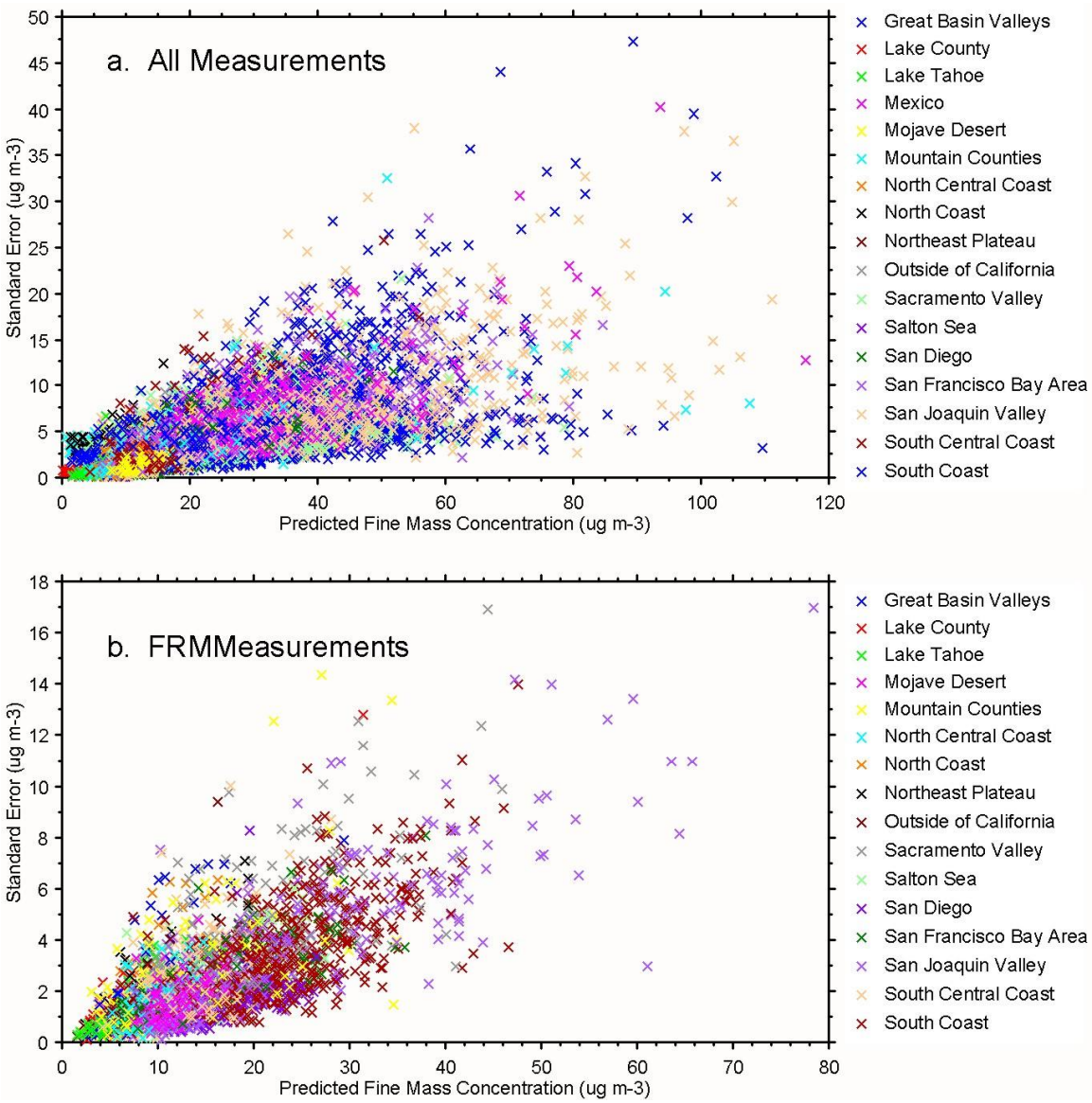

Figure B5. Standard error of the predicted monthly average PM mass concentration versus monthly average fine PM mass concentration. The data include all sites and all months, disaggregated by air basin.

Because the estimated uncertainties increased with increasing monthly average concentration, air basins with higher PM levels tend to have higher uncertainties associated with the monthly averages (Figure B6). However, on a percentage basis, the uncertainties typically were not greater for the higher-PM air basins.

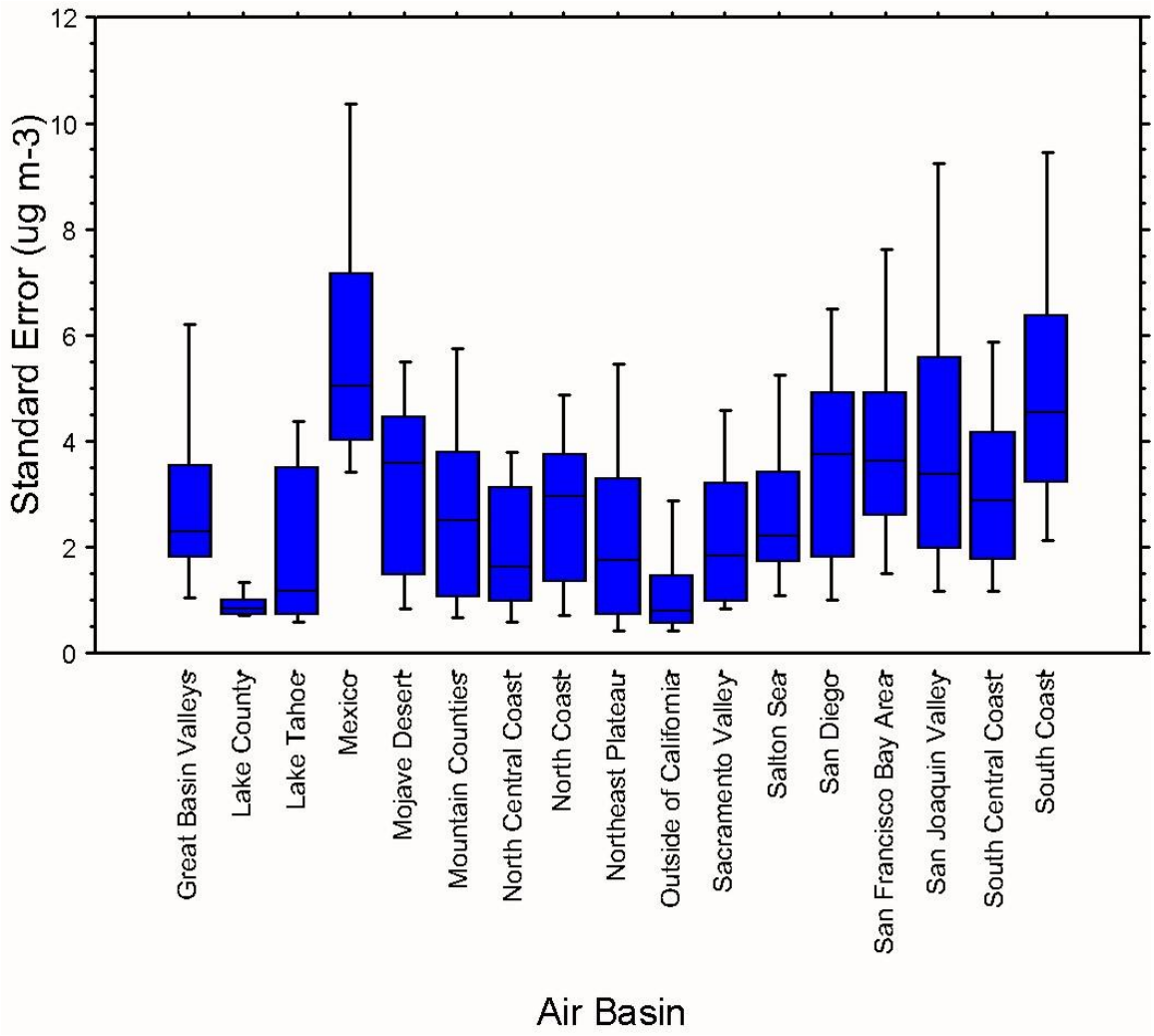

Figure B6. Statistical distributions of the standard error of monthly average PM mass concentration versus air basin. The data include all sites and all months.

The uncertainties of monthly averages varied over time (Figure B7). For the most recent years (1999-2002), most of the monthly averages were determined from daily FRM measurements, so there was no uncertainty associated with the conversion of one set of measurements to the equivalent FRM value (prediction s^2, Equation B1) (Figure B8). Moreover, sampling frequency was generally greater in the most recent years. The median estimated uncertainties were also lower during the earlier years when the only available estimates were from the nephelometer data (1980 through 1984, except 1982) (Figure B8), because the nephelometer measurements were made every day of each month.

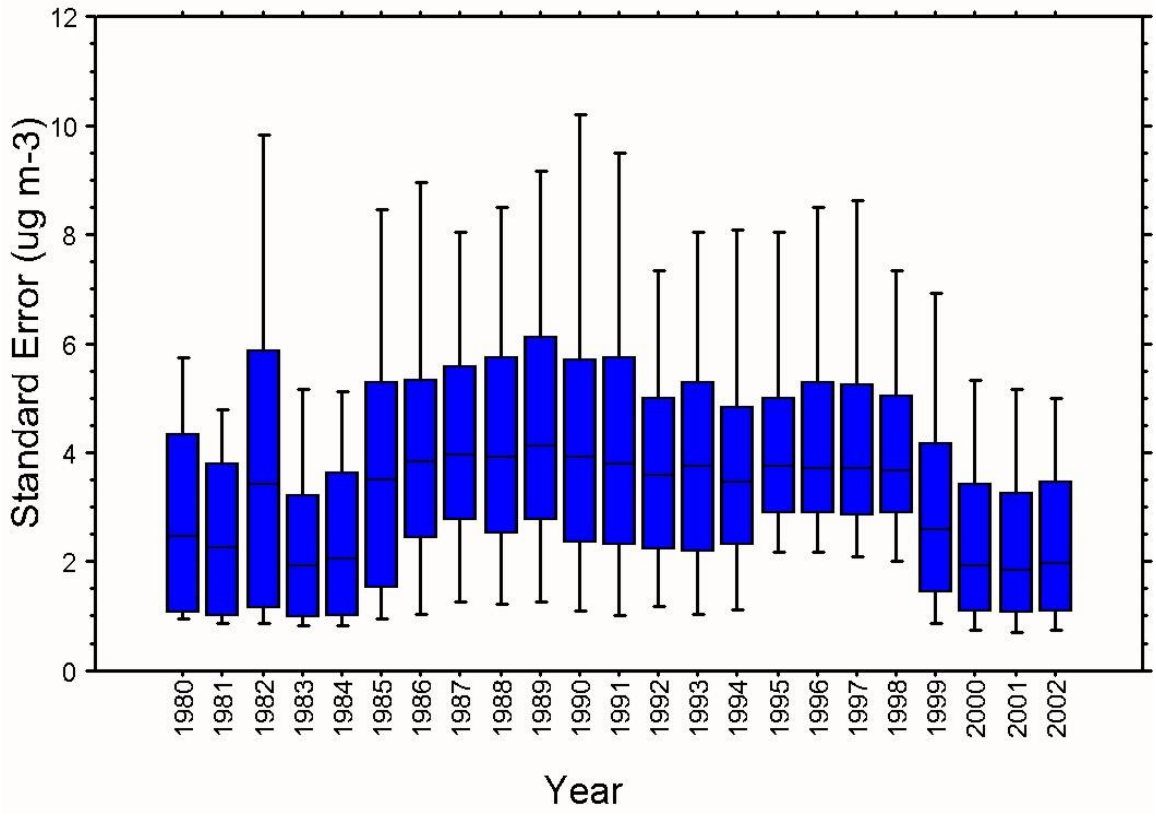

Figure B7. Statistical distributions of the standard error of monthly average PM mass concentration versus year. The data include all sites and all months.

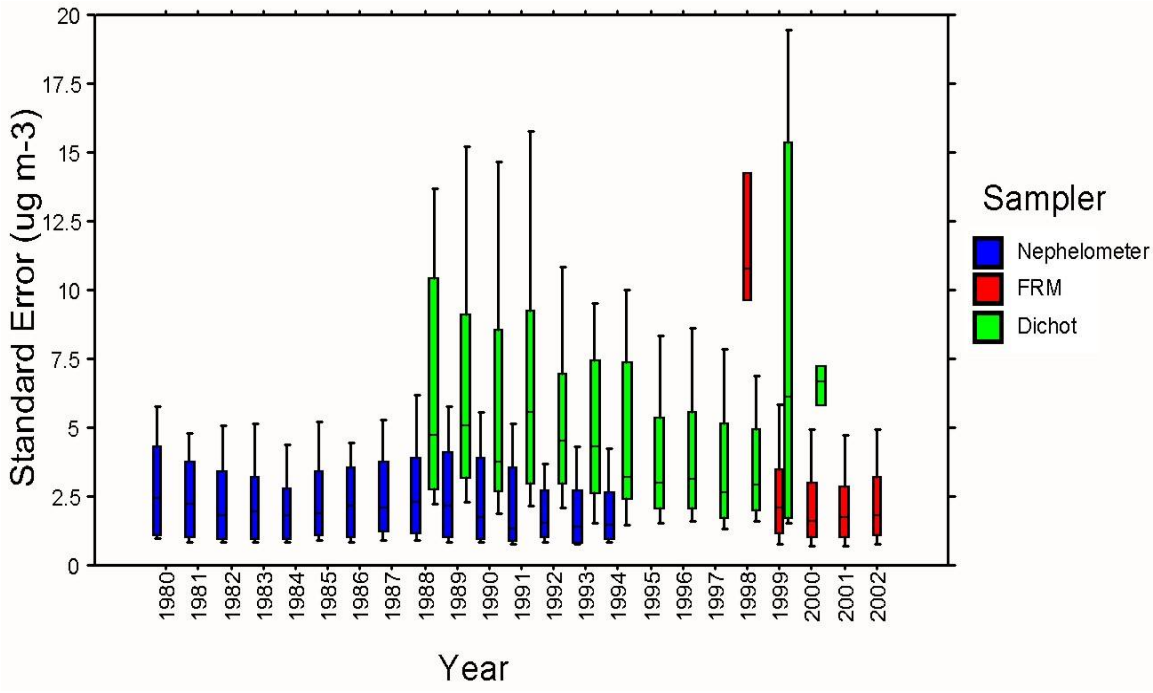

Figure B8. Statistical distributions of the standard error of monthly average PM mass concentration versus year, shown for monthly averages consisting of measurements from nephelometers, FRM samplers, and dichotomous samplers. The distributions of the standard errors of the monthly averages are atypical for the FRM samplers in 1998 and the dichotomous samplers during 1999 and 2000 due to incomplete sampling (e.g., in 1998, FRM measurements were limited to 4 sites with data from December; in 1999, dichot data were available from 1 site for 8 months).

APPENDIX C. COMPARABILITY OF FRM AND DICHOTOMOUS SAMPLER MEASUREMENTS

The FRM measurements commenced in 1998 at 6 sites in the Sacramento Valley and in 1999 at other monitoring sites (Table C1). In 2002, FRM data were reported from 82 monitoring sites statewide.

The availability of fine mass measurements from the dichotomous samplers is summarized in Table C2. This record extends back to 1988, with the largest number of sites in the San Joaquin Valley.

The dichotomous sampler fine mass measurements averaged approximately 15 percent lower than collocated FRM measurements; when adjusted using a conversion factor derived from linear regression, the dichot values agreed well with the FRM data (Figure C1). Differences in the FRM-dichot conversion factors among sites were minimal. However, site-specific conversion factors improved the agreement between FRM and dichotomous sampler measurements (Figure C2). For sites having both FRM and dichot data, site-specific conversion factors were therefore applied to the fine mass concentrations from the dichotomous samplers. For other sites, the generic conversion factor (Figure C1) was applied.

Note that the FRM measurements were reported at ambient temperature and pressure, whereas the dichot measurements were reported at standard temperature and pressure (STP). Without daily temperature and pressure data, it was not possible to convert from STP to ambient conditions. For the site-specific regressions, systematic differences between values reported at STP and those reported at ambient conditions are accommodated within the regression coefficients. However, a possible bias could occur in applying the generic regression coefficients (determined from measurements made at sites typically at elevations close to sea level) to higher elevation (e.g., > 500 m) sites. We therefore adjusted the dichot data for elevation. The unadjusted generic regression of FRM measurements against dichotomous-sampler data was:

C1. $FRM = -0.12 + 1.15*dichot$ ($r^2 = 0.96$)

The generic conversion factor equation was:

C2. $FRM = -0.017 + 1.16*dichot*AF$

Where the adjustment factor (AF) for elevation was:

C3. $AF = \exp[-0.1146*elevation\ (m)/1000]$

Equation C3 reflects the exponential decrease in atmospheric pressure with elevation above the earth's surface:

C4. $P_z = P_0*\exp[-M_a\ g\ z\ /R\ T]$

where: P_z = atmospheric pressure at height z

P_0 = atmospheric pressure at mean sea level

M_a = mean molecular weight of atmosphere, 28.97 g mol^{-1}

g = acceleration of gravity at earth's surface, 9.8 m sec^{-2}

z = height above mean sea level

R = ideal gas constant, 8.314 J deg^{-1} mol^{-1}

T = temperature, kelvin

Concentrations at STP are converted to ambient conditions by multiplying them by the ratio P_z/P_0. We used T = 298 K, yielding Equation C3.

Table C1. Number of sites with fine PM measurements from FRM samplers, by air basin and year.

YEAR	AIR BASIN																
	GBV	LC	LT	MD	MC	NCC	NC	NEP	SV	SS	SD	SFB	SJV	SCC	SC	MEX	OUT
1998	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
1999	1	1	1	4	5	2	2	1	9	4	5	9	9	7	16	0	0
2000	2	1	2	4	5	2	2	1	9	5	5	9	11	8	16	0	0
2001	2	1	2	5	5	2	2	1	9	5	5	9	11	7	16	0	2
2002	1	1	2	4	5	2	2	1	9	5	5	10	11	7	16	0	2

Table C2. Number of sites in each air basin that have fine PM data from dichotomous samplers, by year.

YEAR	AIR BASIN																
	GBV	LC	LT	MD	MC	NCC	NC	NEP	SV	SS	SD	SFB	SJV	SCC	SC	MEX	OUT
1988	0	0	0	0	0	0	0	0	0	1	0	1	4	0	3	0	0
1989	2	0	0	0	0	0	0	0	0	1	0	0	8	0	3	0	0
1990	2	0	0	0	0	0	0	0	0	1	0	1	10	0	3	0	0
1991	2	0	0	1	0	0	0	0	1	2	0	1	9	0	3	0	0
1992	2	0	0	1	0	0	0	0	1	2	0	1	8	0	3	0	0
1993	3	0	0	1	0	0	0	0	1	2	0	1	8	0	3	0	0
1994	2	0	0	0	0	0	0	0	1	2	0	1	9	0	3	0	0
1995	3	0	0	0	0	0	0	0	1	2	0	1	8	1	3	0	0
1996	2	0	0	1	0	0	0	0	1	2	0	1	9	0	3	0	0
1997	2	0	0	1	1	0	0	0	1	1	0	1	8	0	3	0	0
1998	2	0	0	1	1	0	0	0	1	1	0	1	9	0	2	0	0
1999	2	0	0	1	1	0	0	0	1	1	0	1	7	0	2	0	0
2000	0	0	0	1	0	0	0	0	1	1	0	1	7	0	2	0	0
2001	0	0	0	0	0	0	0	0	3	1	0	0	1	0	0	0	0
2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

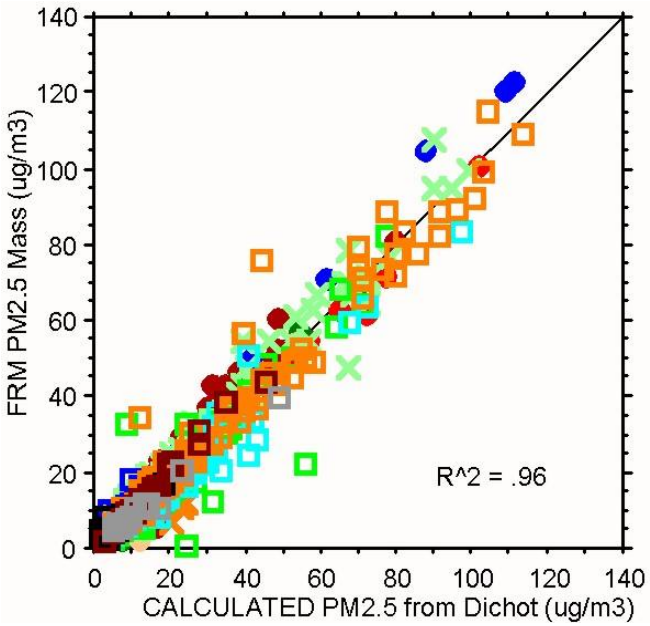

Figure C1. Comparison of fine PM mass measured by FRM and dichotomous samplers. The dichot measurements were converted to FRM equivalent values from the regression equation FRM = -0.017 + 1.16*dichot*AF (r^2 = 0.96), where AF is an elevation-adjustment factor. Each point represents a daily-average sample with collocated FRM and dichotomous sampler measurements. Symbols represent different monitoring locations.

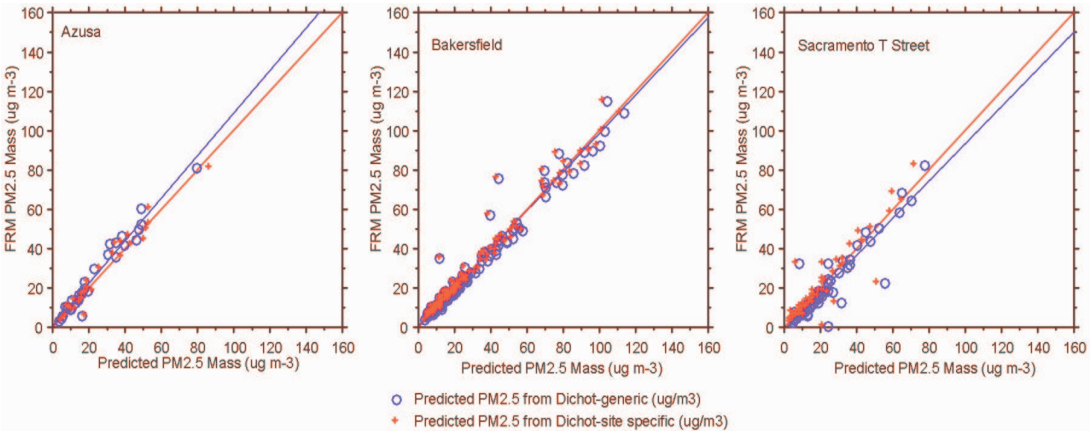

Figure C2. Comparison of fine PM mass measured by FRM and dichotomous samplers showing the effects of using site-specific or generic conversion factors. The generic conversion factor was obtained from the regression equation FRM = -0.017 + 1.16*dichot*AF (r^2 = 0.96), where AF is an elevation-adjustment factor. Each point represents a daily-average sample with collocated FRM and dichotomous sampler measurements.

APPENDIX D. COMPARABILITY OF MEASUREMENTS FROM DICHOTOMOUS SAMPLERS AND SPECIAL STUDIES

Most of the data from special studies were obtained prior to the implementation of the FRM monitoring network. However, the special-study data can be compared to measurements from the dichotomous samplers, as a number of monitors were collocated.

Measurements of fine mass from the California Acid Deposition Monitoring Program (CADMP) agreed well with the dichotomous samplers at three of the four collocated sites (Figure D1), with Bakersfield being the exception. Therefore, a conversion factor for adjusting the CADMP fine mass concentrations to their equivalent dichotomous sampler concentrations was determined using the three sites of Azusa, North Long Beach, and Sacramento, and the Bakersfield CADMP were not subsequently used.

The daily-average fine mass measurements from each of four special studies exceeded the dichotomous samplers by ~ 10 to 30 percent on average (Figure D2), but the correlations were strong (r^2 values of 0.84 to 0.94). To convert the data from these special studies to FRM equivalent, we applied a two-step process. The first step was a conversion to the dichot equivalent, followed by conversion from dichot equivalent to FRM equivalent as described in Appendix C. For the first step, we used no-intercept regressions, which yielded:

D1. Dichot = 0.914*CADMP (+/- 0.014)
Dichot = 0.716*VAQS (+/- 0.020)
Dichot = 0.898*CalTech (+/- 0.017)
Dichot = 0.845*PTEP (+/- 0.016)

The no-intercept regressions fit the data and permitted a more straightforward propagation of uncertainties through the two-step conversion than would the regressions with intercept terms included (i.e., those shown in Figure D2).

The data from the two-week sampler that has been used in the Children's Health Study could not be compared on a daily-average basis to the FRM measurements. Instead, we obtained monthly averages of the two-week sampler data from the CARB and compared those with monthly averages of the FRM data (Figure D3). The FRM fine mass concentrations averaged ~12 percent greater than the TWS values, but the correlations were very strong. We used the no-intercept regressions to obtain a conversion factor for converting the TWS measurements to FRM equivalent.

Like the dichotomous-sampler data, the measurements from special studies were reported at standard temperature and pressure. We therefore converted the special-study data to their dichot-equivalent values (Equation D1), with the adjustment to ambient conditions being accommodated by the conversion from dichot-equivalent to FRM-equivalent values as described in Appendix C.

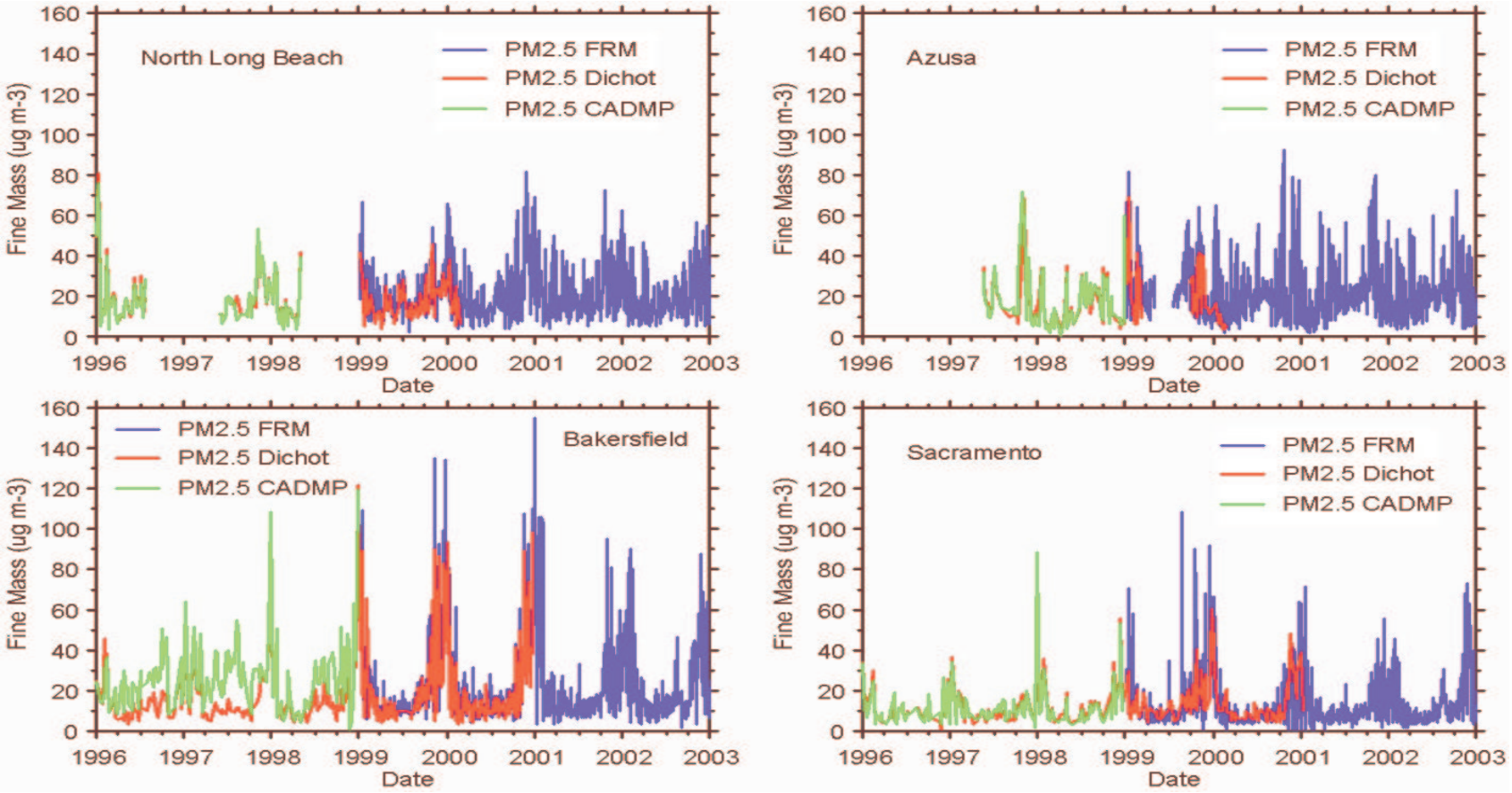

Figure D1. Time series of daily-average fine-mass concentrations from the CADMP, dichotomous sampler, and FRM networks.

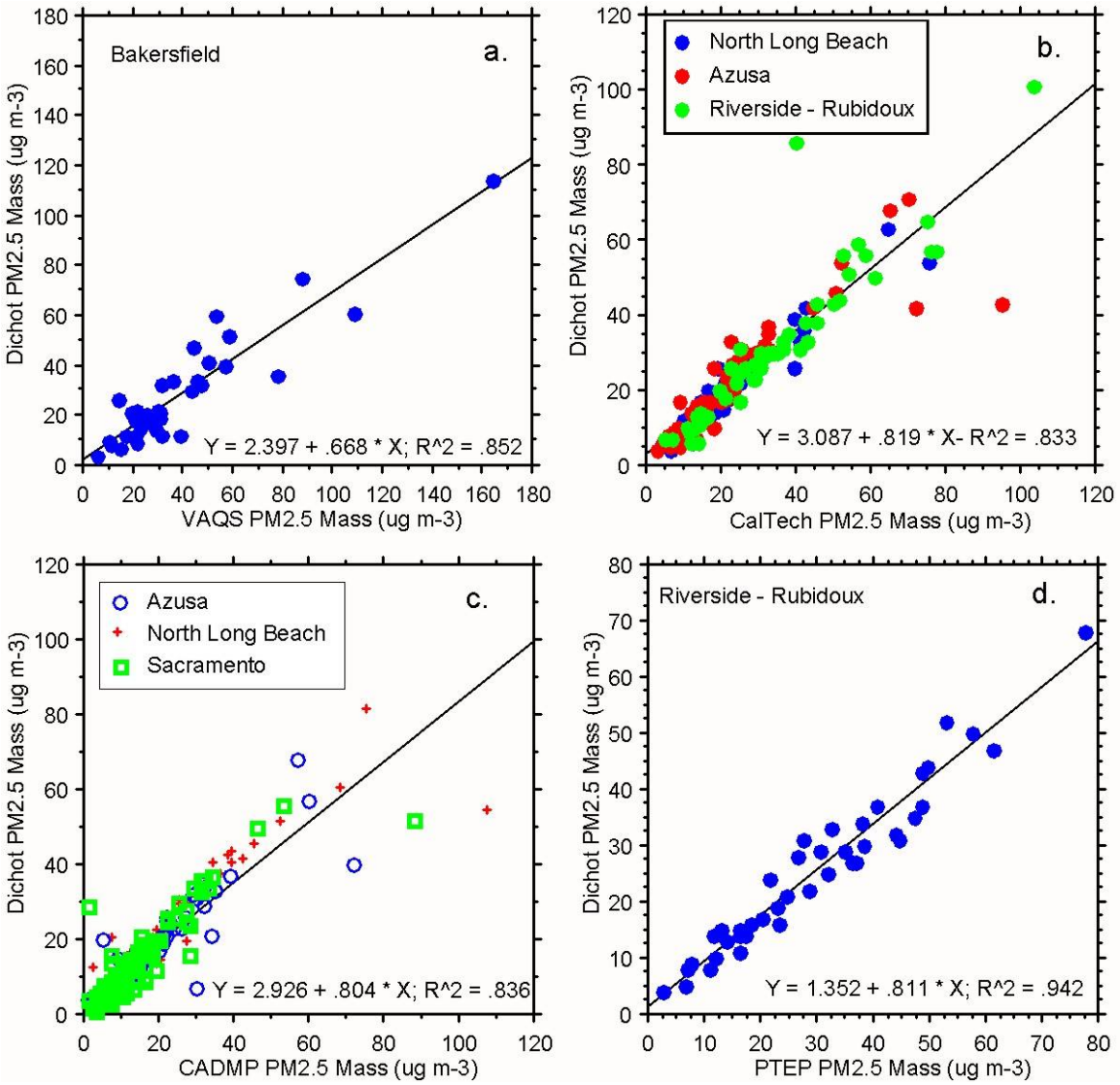

Figure D2. Comparisons of daily-average fine mass measurements from dichotomous samplers with measurements of fine mass from (a) the Valley Air Quality Study (VAQS, 1988-89), (b) the CalTech program (1993), (c) the California Acid Deposition Monitoring Program (CADMP, 1996-99), and (d) the PM_{10} Enhancement Program (PTEP, 1995-96).

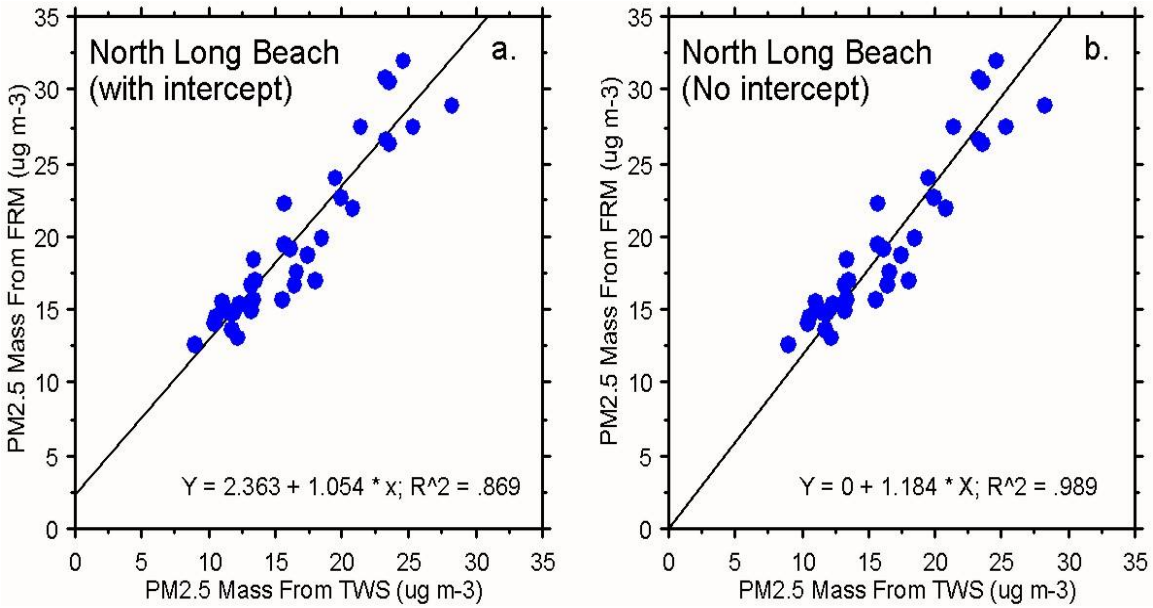

Figure D3. Monthly-average fine mass concentrations measured at North Long Beach by the FRM and two-week samplers showing regressions (a) with intercept and (b) without intercept.